بسم الله الرحمن الرحيم

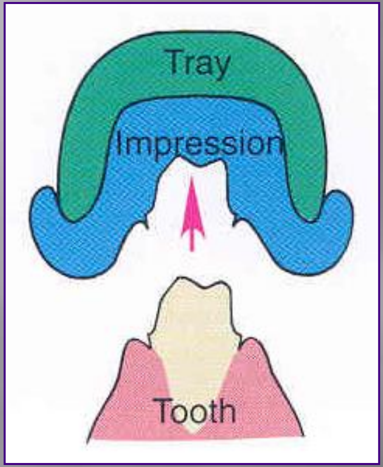
WAX PATTERN

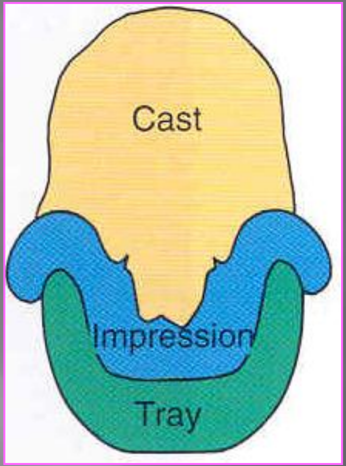
By

Dr. Lamia Dawood

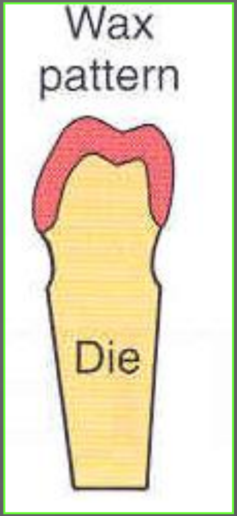
Lost-wax process

accurate impression of the prepared tooth

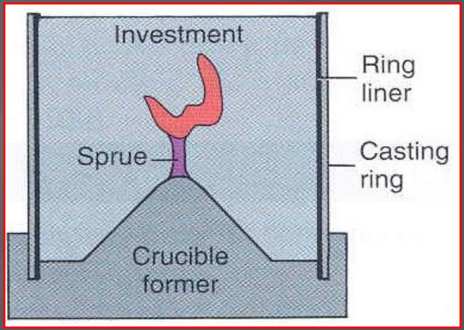




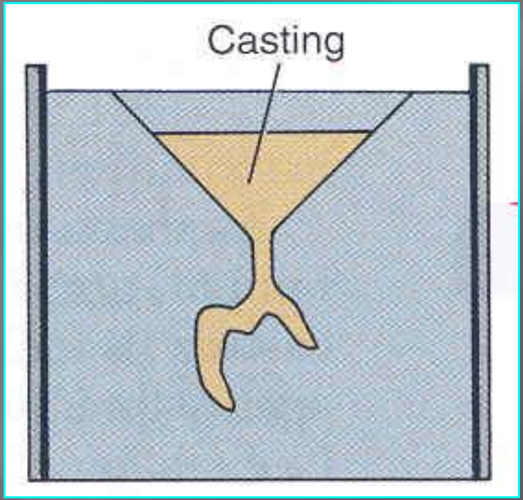
making a cast



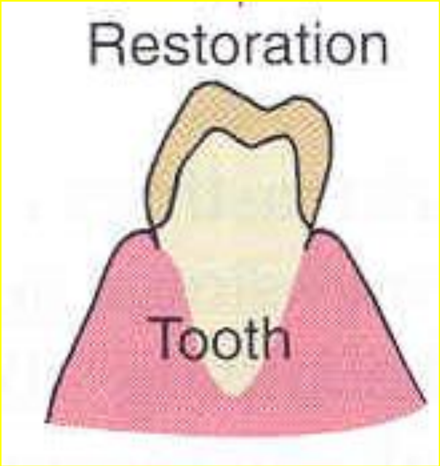
A wax pattern is shaped on the cast .



mold is then made with refractory investment material



The hollow mold is filled with molten casting alloy



Remove excess metal , polishing, ready for clinical evaluation

Die preparation prior to wax pattern construction :

Correction of defects

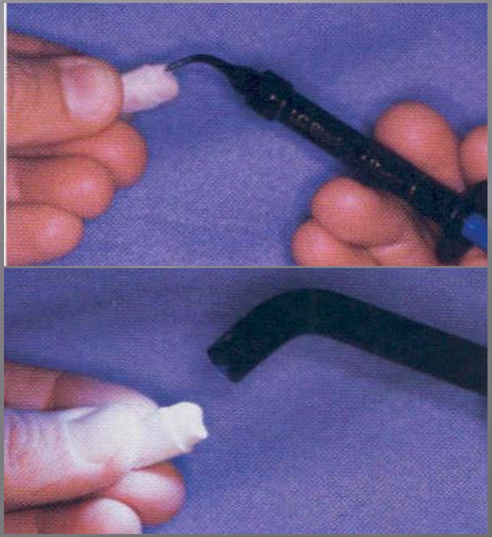
- Any small dimples (undercut) in die must be corrected
- This correction can be made :

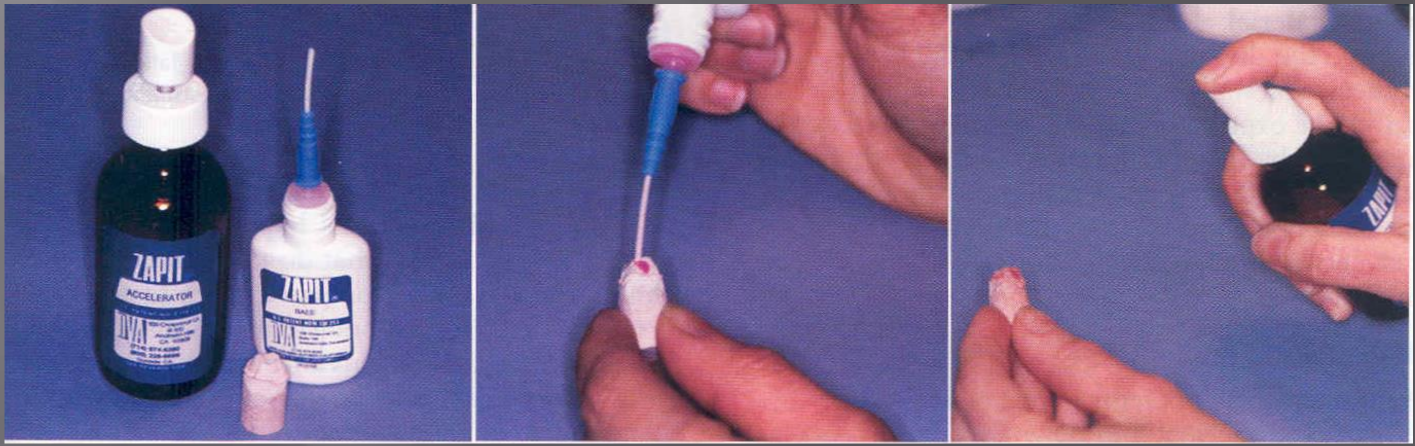
a- Clinically : with glass ionomer or amalgam or others .

b- Laboratory : blocking them out on the working die by :

1- Zinc phosphate cement

2- Other commercial products (e.g., resin)

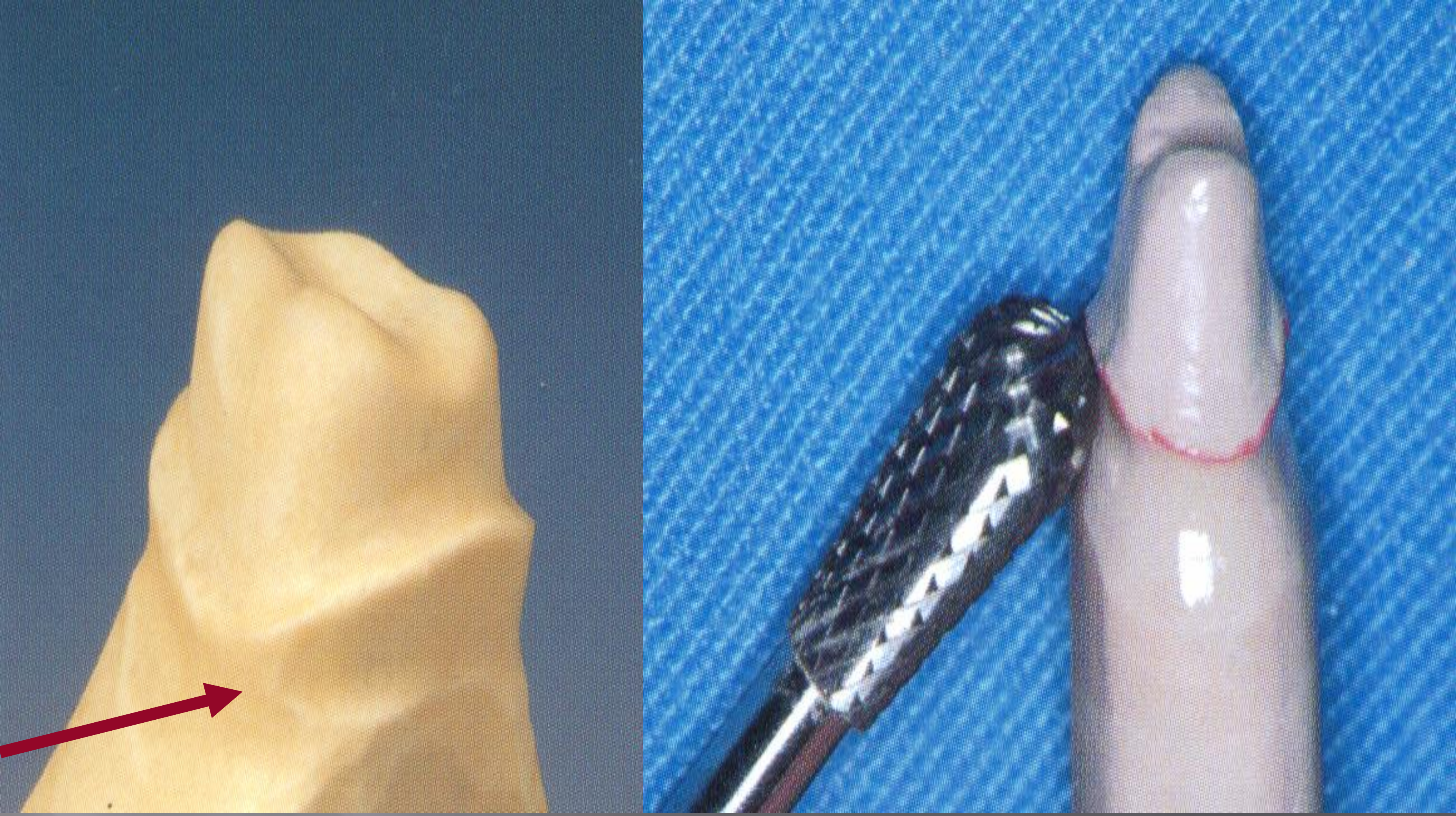




1. *If the free gingiva is represented on the die at a higher level than the finish line it should be trimmed away to define the margin.*

Die trimming:

- Remove most of excess stone with Arbor band.
- Use a pear shaped acrylic bur to trim the die apical to the finish line of the preparation.
- Then fine trimming and smoothening with scalpel or cleoid-discoid carver.

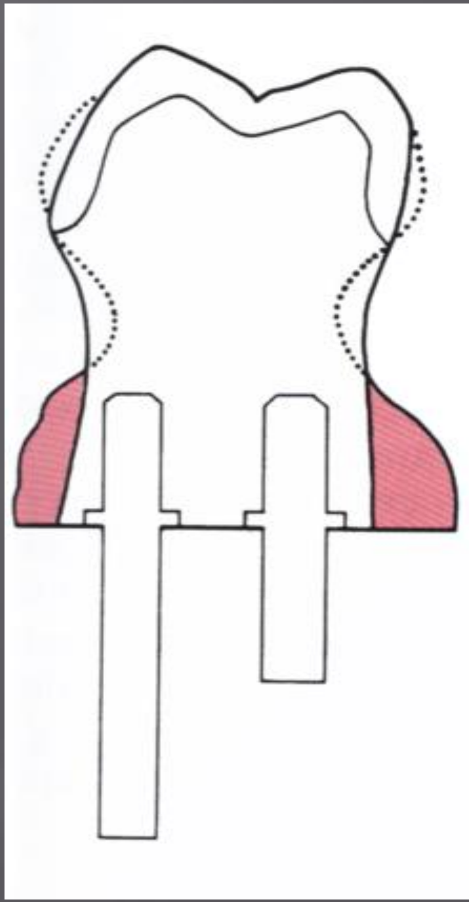


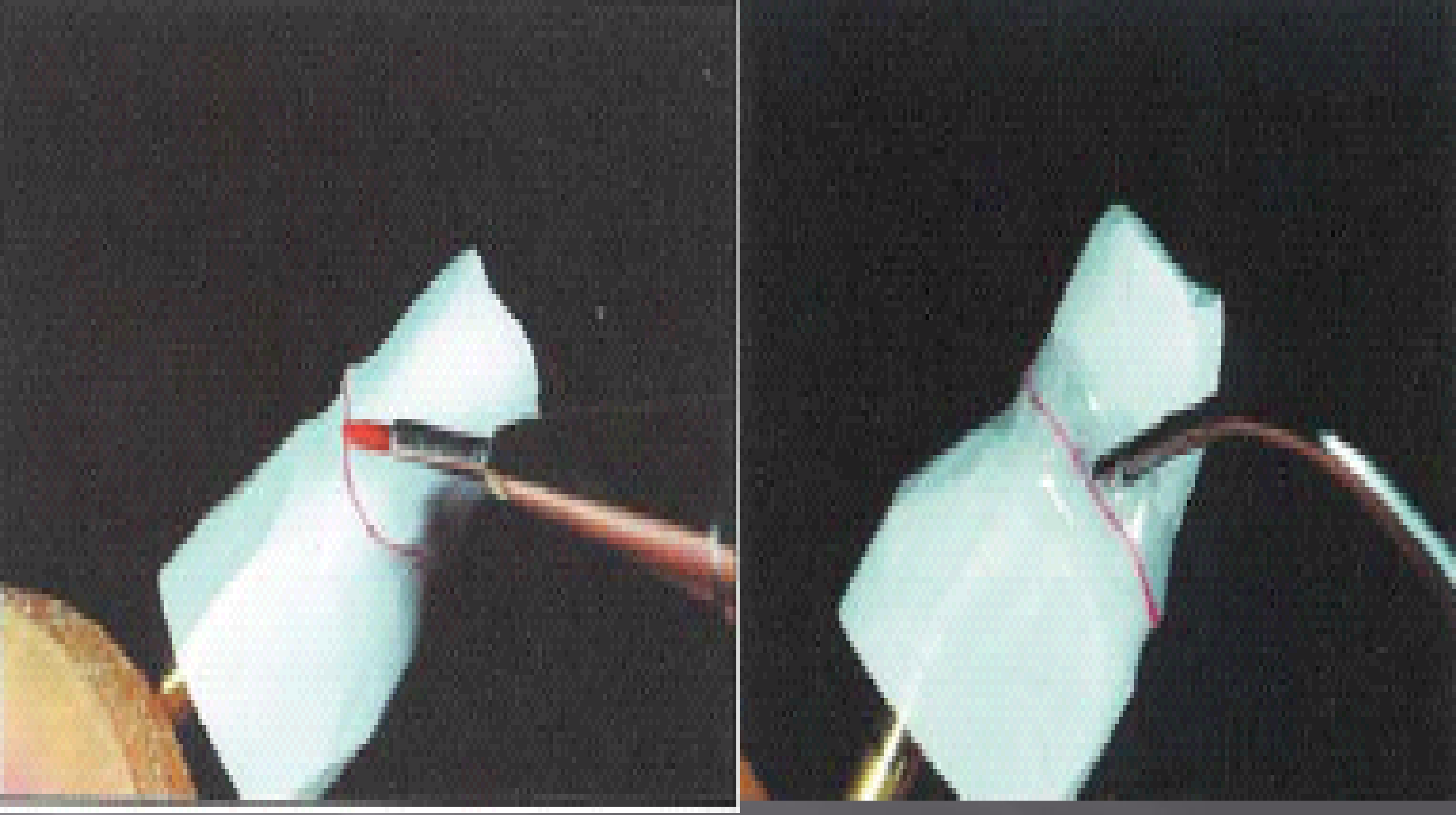
2- Ditching of the die below the finish line to 0.3 mm. Ditching is a circumferential groove that facilitates the establishment of good margin.

Advantages of die trimming:

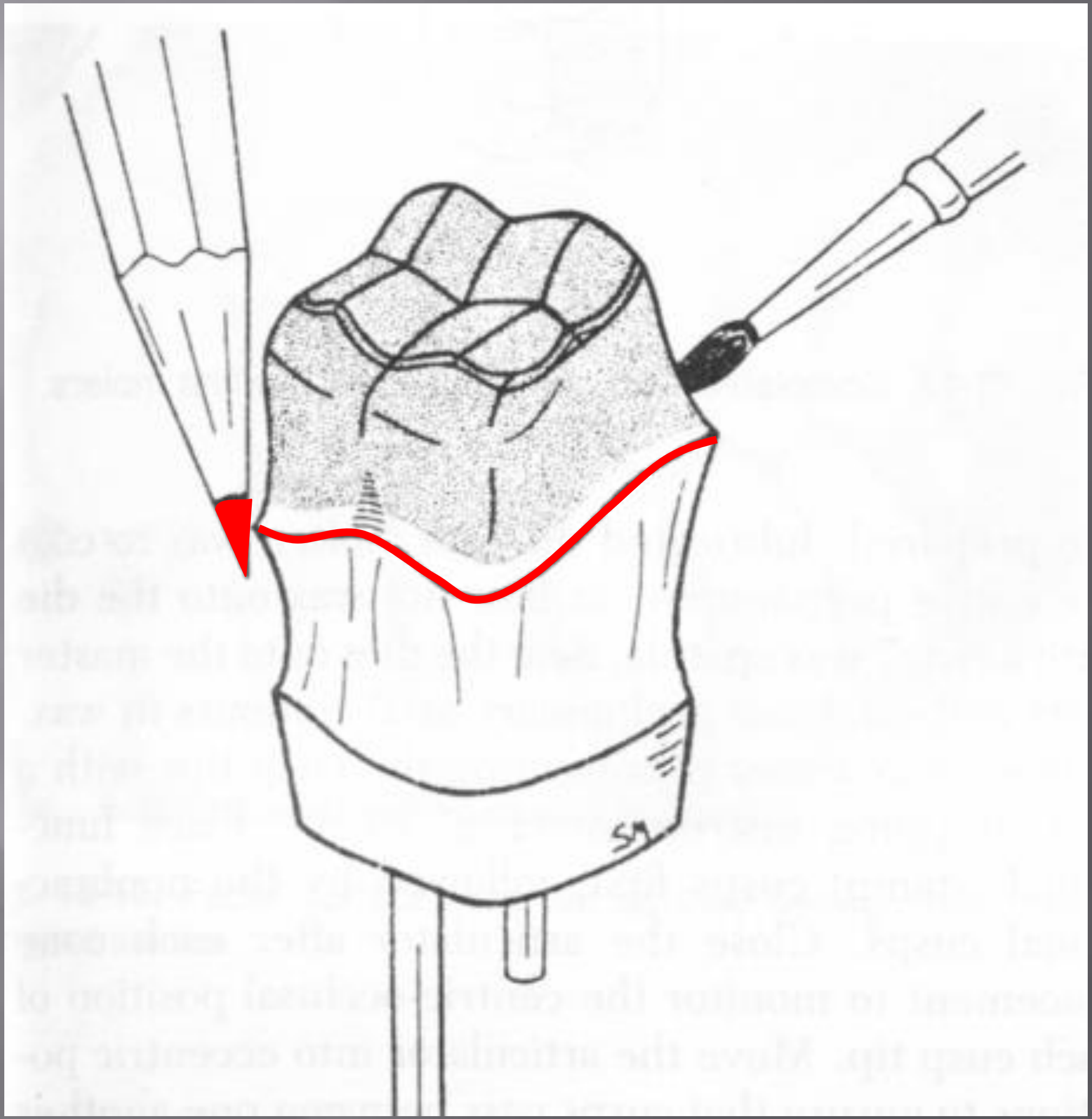
- Accentuate the finish line.
- Resembling the normal contour of the natural root for proper cervical contouring of the wax pattern.
- Produce smooth area gingival to the finish line.

The original contour of the tooth structure below the margin must be preserved. Over trimming (dotted line) will result in over contoured restoration





The finish line of the preparation should be colored by red pencil without any pressure to preserve the finish line without scratches.



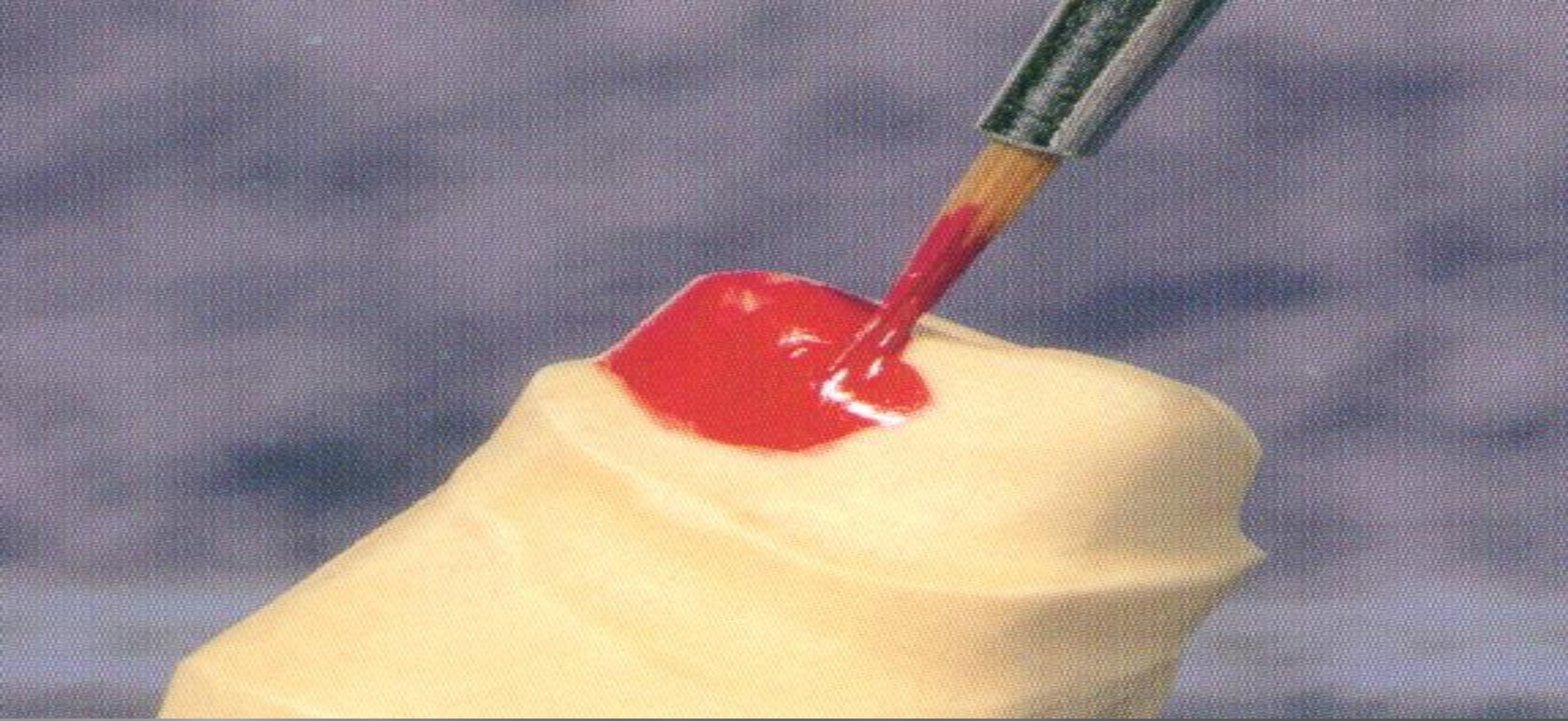
Die Preparation

- **. Apply die hardener**
  - Cover die beyond finish lines.
  - Allow to set for 5 minutes.

STONE DIE
& PLASTER
HARDENER
RESIN
A LIQUID PLASTIC which impregnates the stone die. Hardens stone, protects margins, seals and waterproofs. Does not change dimensions of die, or model.
Brush liquid on the stone die or model. Apply 1 or 2 thin coats, allowing 10 to 15 seconds between applications for liquid to be

. Apply die spacer

- 40 micron thickness allows space for cement.
- 2-3 coats placed.
- Spacer 1 mm away from finish line.
- Remove excess with die setting retardant.



Die spacer is used to maintain constant space between the side walls of the preparation and the restoration.

A band of about 1 mm must be left unpainted at the margin to maintain good margin adaptation.

Iso-Stift No. 170
(nach Gunther Seubert)

The die is thoroughly lubricated with a water soluble lubricant which decrease the surface tension of the die and enhances the flow of the wax.

factors affecting the size of the cement space :

Increasing the Cement Space :

1. Thermal and polymerization shrinkage of the impression material.
2. Use of a solid cast with individual stone dies.
3. Use of die spacers.
4. Use of an internal (initial) layer of soft wax.
5. Increased expansion of the investment mold.
6. Removal of metal from the fitting surface by grinding, airborne-particle abrasion, etching with aqua regia, or electrochemical milling.

Reduction of the Cement Space :

1. Reduced thermal and polymerization shrinkage of the impression material

2. Use of resin or electroplated die .

3. Reduced expansion of the investment mold which can be done by altering :
   a- technique selection
   b- burnout temperature
   c- water/powder ratio

4. Use of alloy with higher melting range .

Material science

1- Composition : (Blue inlay casting wax)

Base wax – modifier wax – colorant .

- * **Paraffin wax** → 40 – 60 %
- * **Bees wax & carnauba wax**
  - → increase melting temperature
  - → increase stickiness
  - → Increase hardness
- * **Dyes** → provide color contrast

2- Types : ANSI & ADA have classified wax into :

a- Type I: Medium hardness wax

- → Used in direct technique
- → Not flow at mouth temperature
- → Accurate shape
- → Enough strength to resist any deformation
- → Support fine details

b- Type II: Softer wax

- → Used in indirect technique
- → Resist flow at room temperature
- → Maximize fitness between wax and die

3. Requirements of the casting wax:

1- Has different color than the die material.

2- Flow readily and record fine details..

3- Carved without shipping or flaking.

4- Accept addition.

5- Can be finished and polished.

6- Has sufficient strength and rigidity after cooling

7-Shows fracture rather than distortion if it gets in undercut.

8- Shows minimal rate of stress relaxation.

9- Evaporate without residue during burn out.

10- Can compensate part of metal solidification shrinkage.

4- Properties :

a- Flow → depends on the temperature (↑ temp → ↑ flow)

(Type I wax) → carved at 37 C (99 F)

(Type II wax) → carved at 35 C (77 F)

b- Thermal expansion →

Coefficient of Thermal expansion of wax is high

c- Wettability →

* wax is poorly wetted by investment slurry
* overcome by application of surfactant to flow

d- Memory :

* wax exhibits some elasticity till it liquefied .
* overcome by applying the initial layer of wax in melted increments or drops.
* Alternatively, dipping of initial coping in melted wax

Techniques used for fabrication of the wax pattern :

Direct technique.

Indirect technique

Indirect – direct technique

Direct technique:

The pattern is constructed inside the patient mouth as in case of inlay and post wax pattern , the molten wax is pressed by finger inside the cavity and carved in place by sharp carver.

This technique although accurate but it is time consuming and offer lesser accessibility.

Indirect technique :

The pattern is constructed outside the patient mouth on the cast .

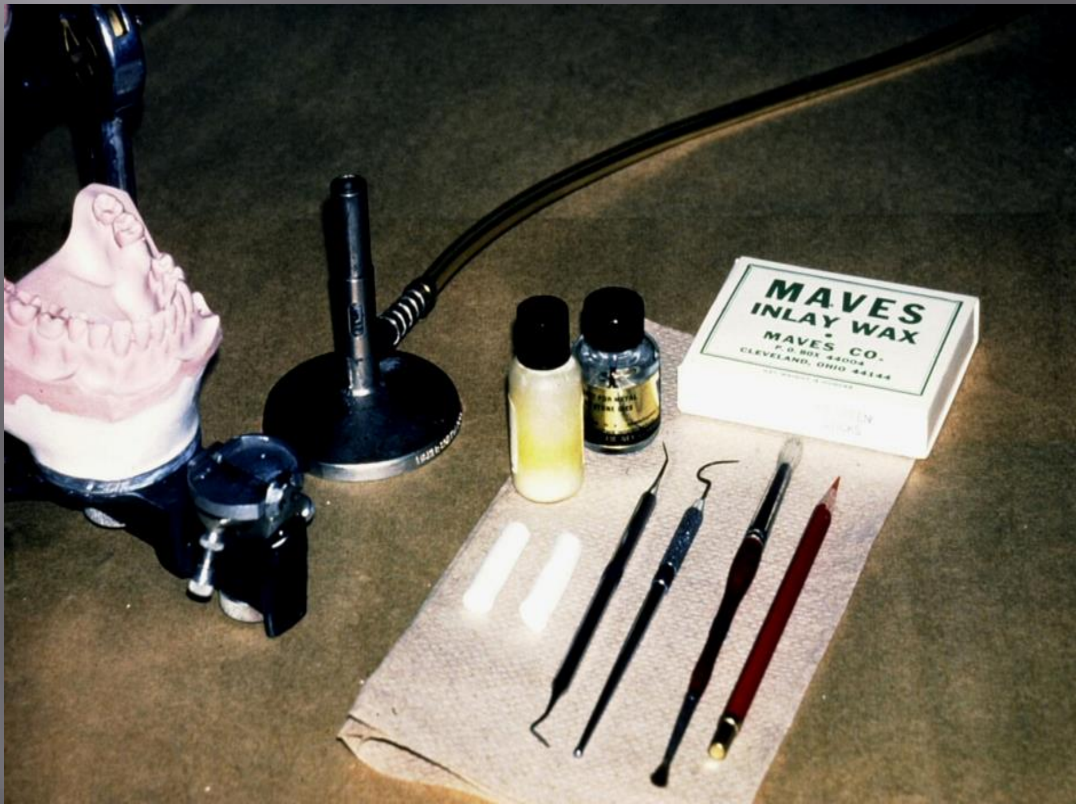
It is the most commonly used method in fixed prosthodontics due to its accessibility, visibility and time saving.

Indirect – direct technique :

The pattern is constructed outside the patient mouth and fine adjustment is carried out inside the patient mouth.

Armamentarium

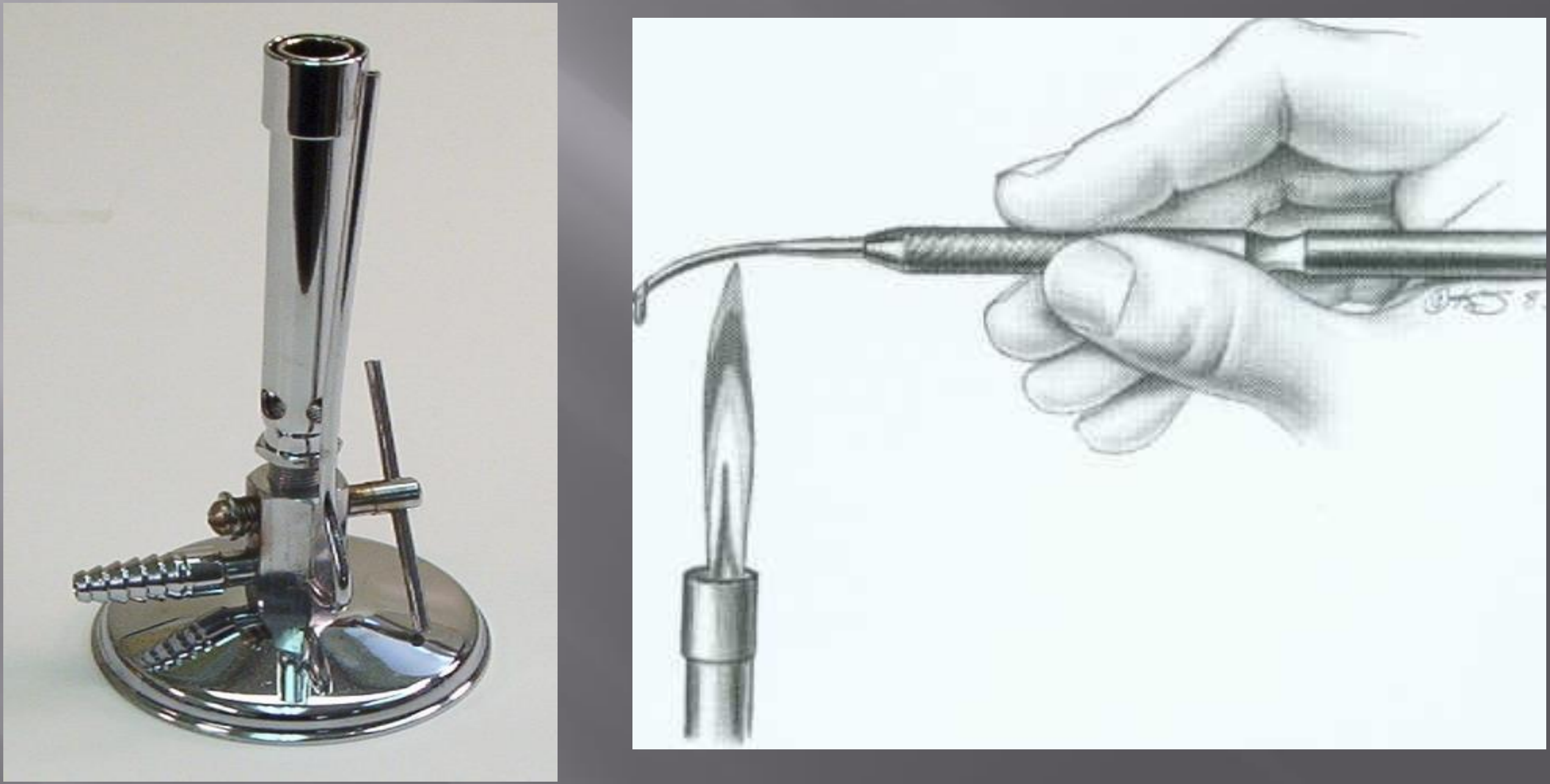
- Bunsen burner.
- Waxing instruments.
- Wax in stick form.
- Die lubricant.
- Powdered wax.
- Sharp contrast color pencil.
- Mounted casts/dies.



- Soft toothbrush.
- Double-sided brushes (soft/rigid)
- Cotton balls.
- Fine nylon hose.
- Shim stock or marking tape.

Armamentarium

- 1- Bunsen burner

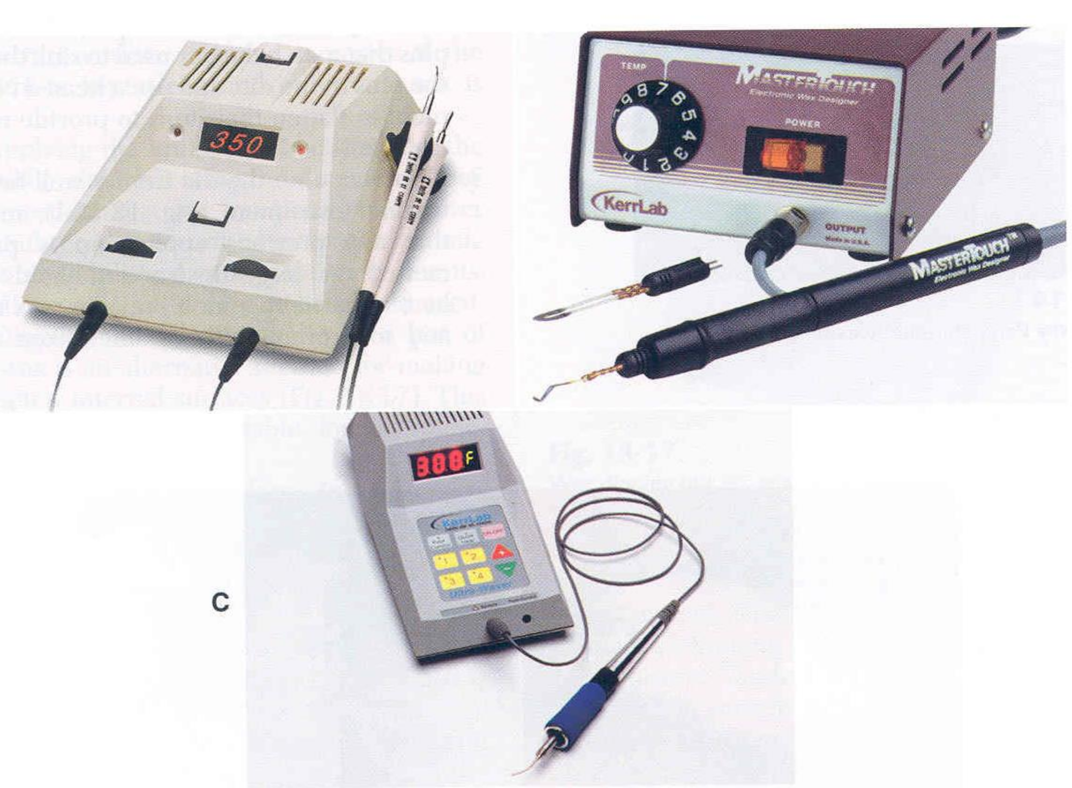


Electric waxing instruments

➔ **They are preferred by some technicians because:**

* They allow controlling temperature of the wax, which is important for proper manipulation.

* Carbon buildup can be kept to a minimum.



Thermojet

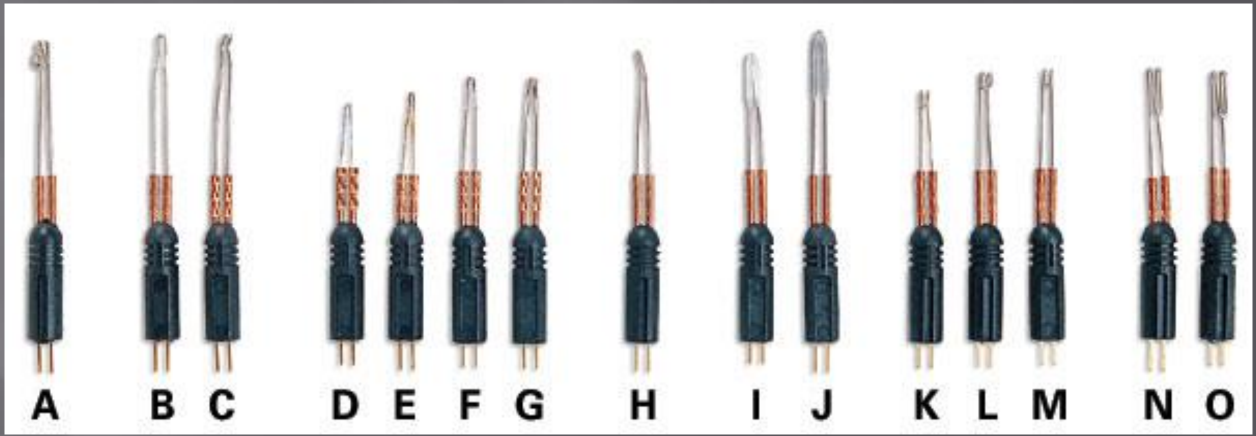
Ultra-Waxer

The ultimate Electronic Waxer features continuous heat with 1°F accuracy or Foot Control operation

Master Touch

Versatile wax pen offering excellent wax control in pattern build-up.

Offers instant tip heating and cooling when used with the optional foot control



Smoothy Flameless Wax Finisher

Produces a flameless jet stream of heated air and is ideal for the final stages of wax pattern sculpturing.

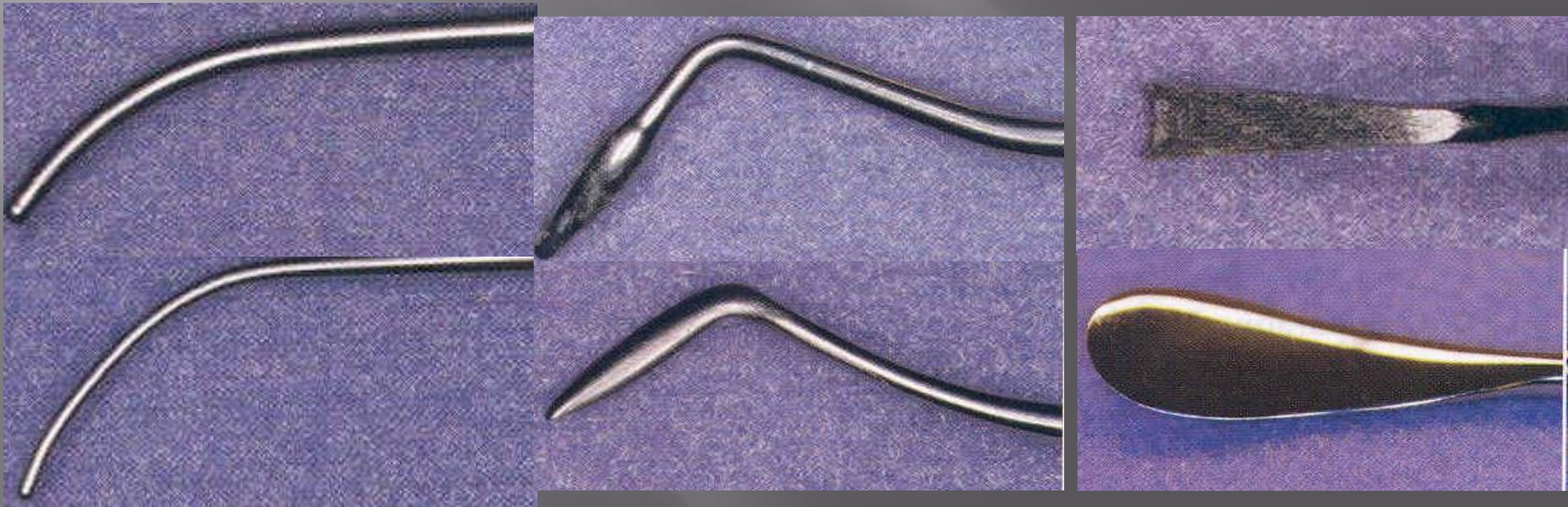
Wet-Waxer

Temperature controlled heating tray that holds up to six tins of wax at temperatures from semi-soft to liquid.

- 2. Waxing instruments (Peter K Thomas)
  can be categorized by their design:

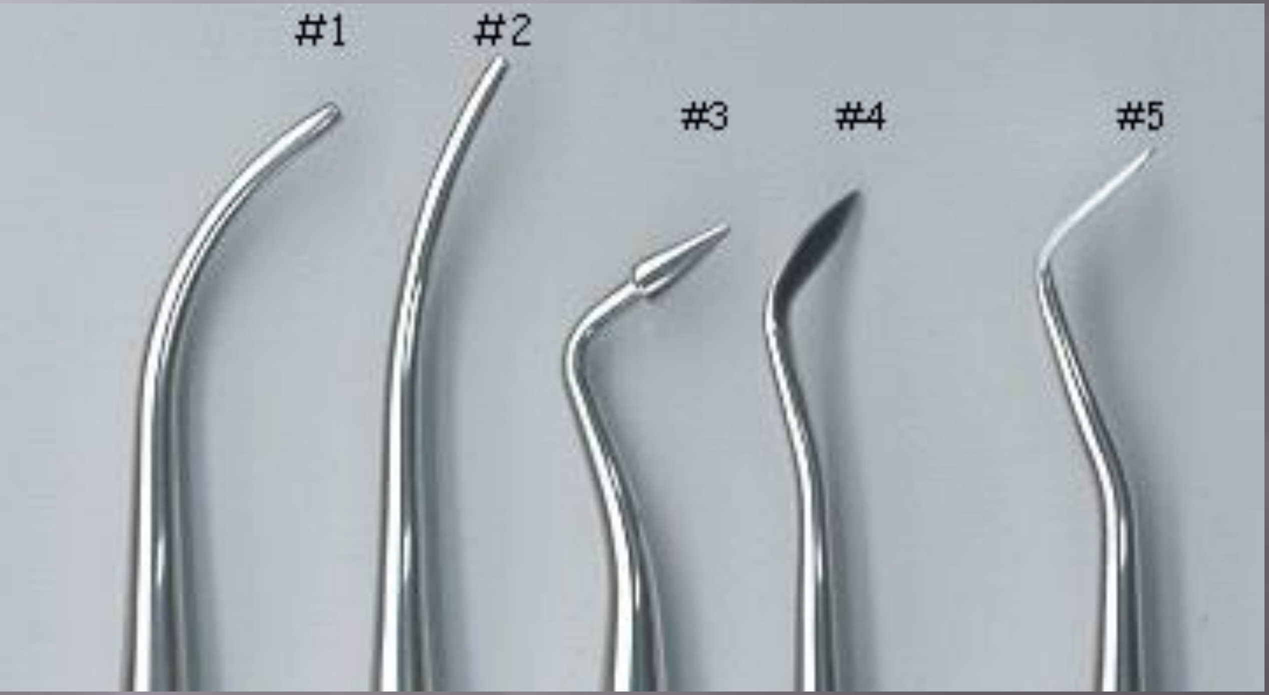
➢ wax addition, burnishing, or carving (PKTs)

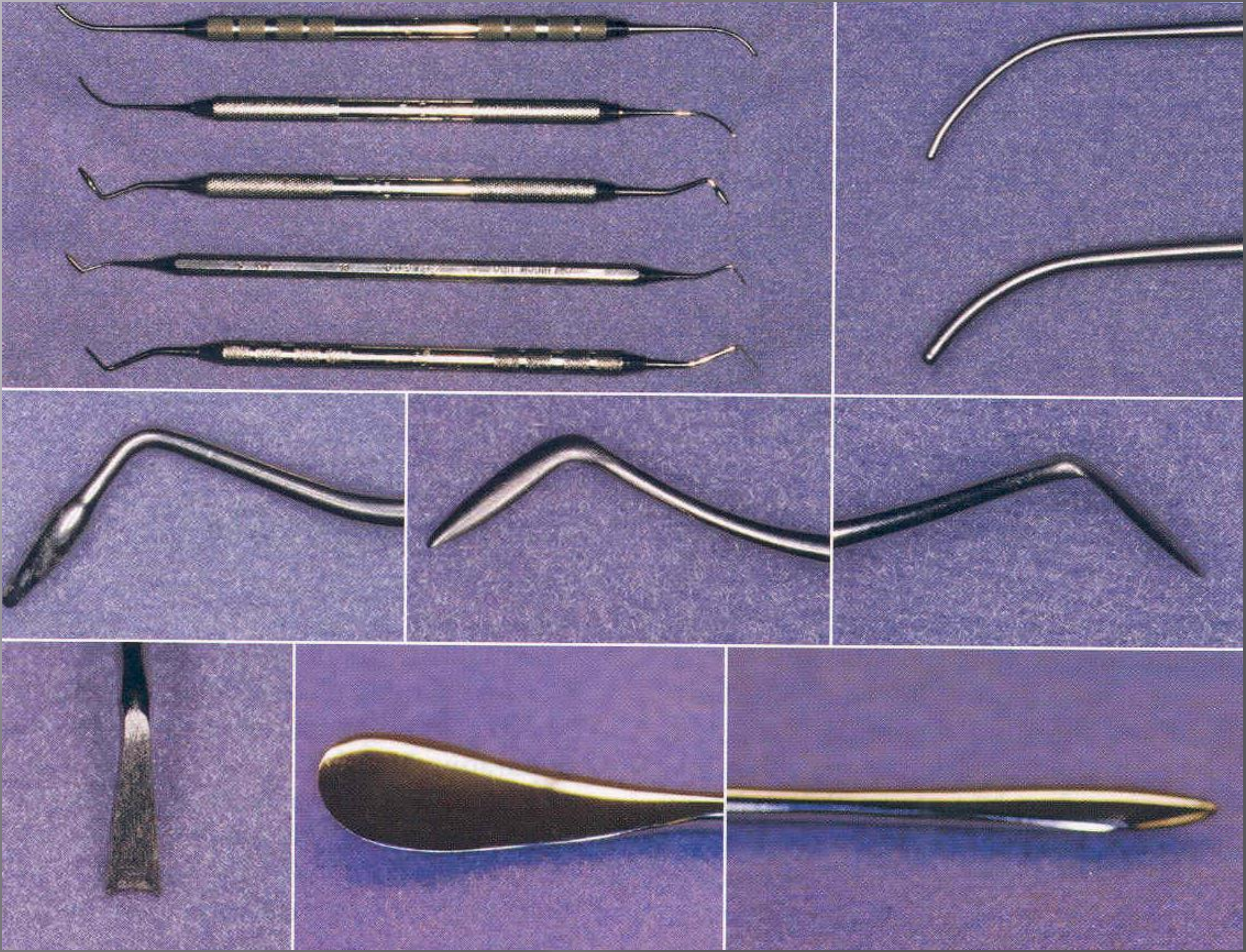
- → no. 1 for adding large increments.
- → no. 2 for lesser addition.
- → no. 3 is a burnisher for refining occlusal anatomy.
- → nos. 4 and 5 are wax carvers.
- → no 7 or 7A waxing spatula for adding large amounts of wax.



Waxing Instruments

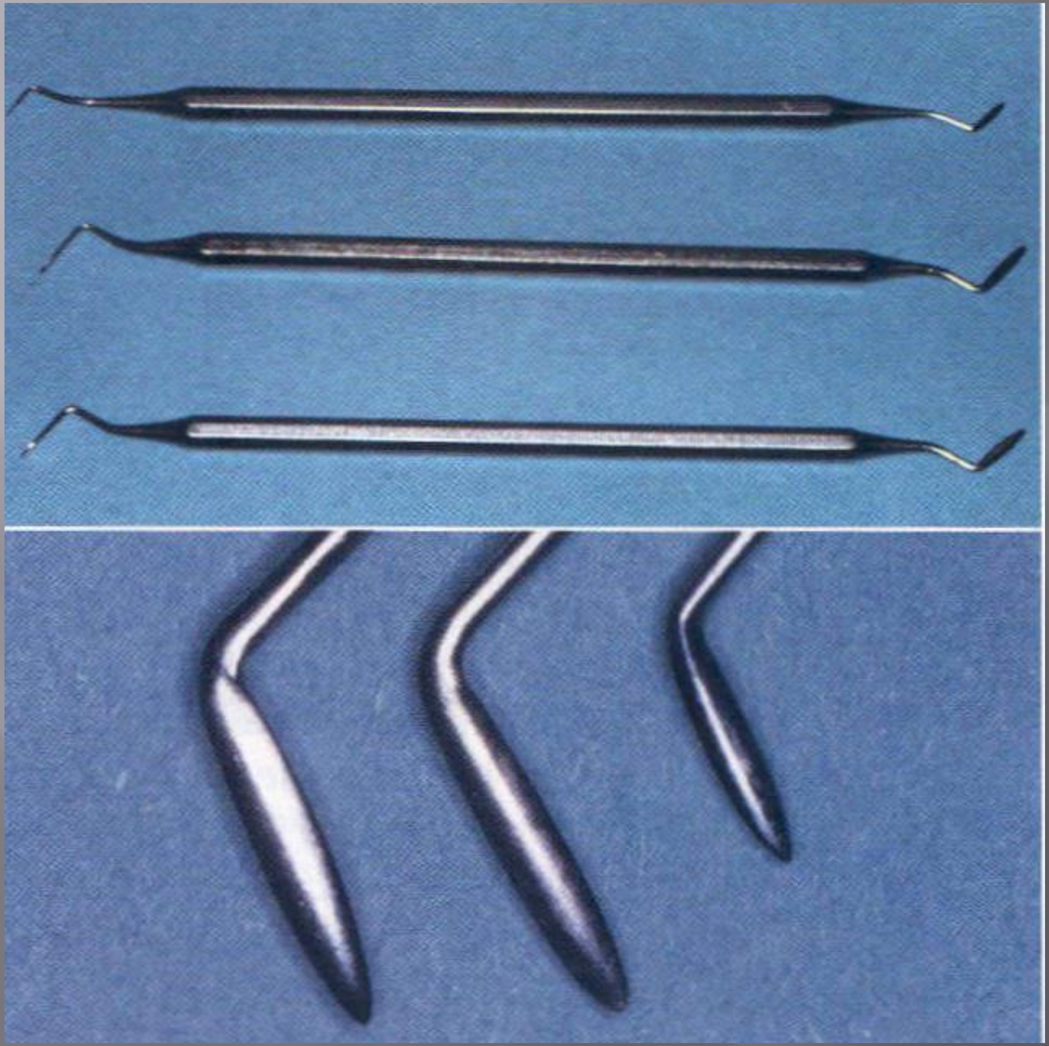
Peter K Thomas (PKT 1-5)



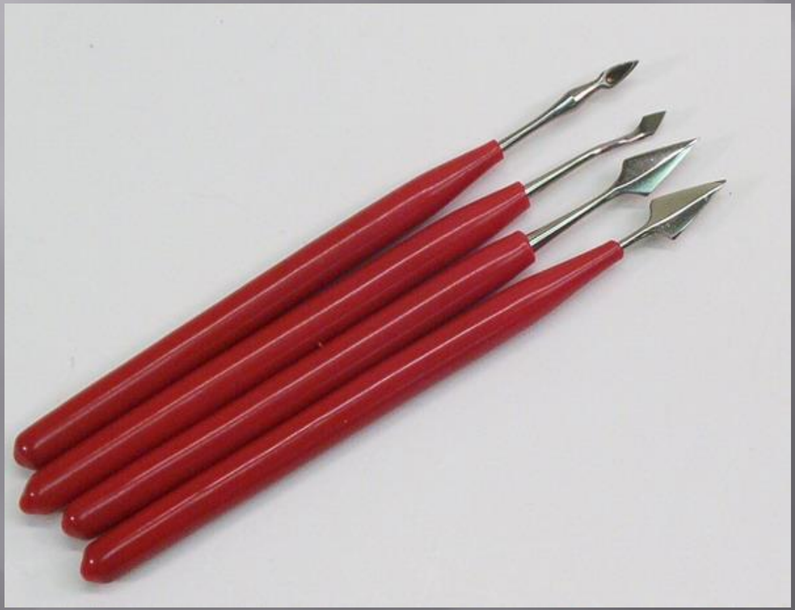


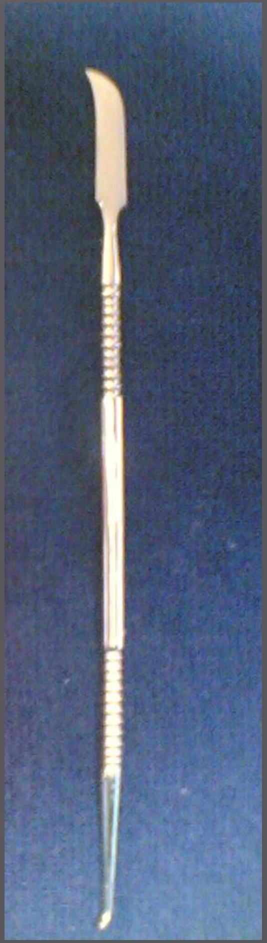
In addition to the PKT instruments :

- no. ½ and 3 Hollenback and the no. 2 Ward carvers
- no 6 DPT (Darby Perry trimmer) → for removing wax .



3- Wax Carvers





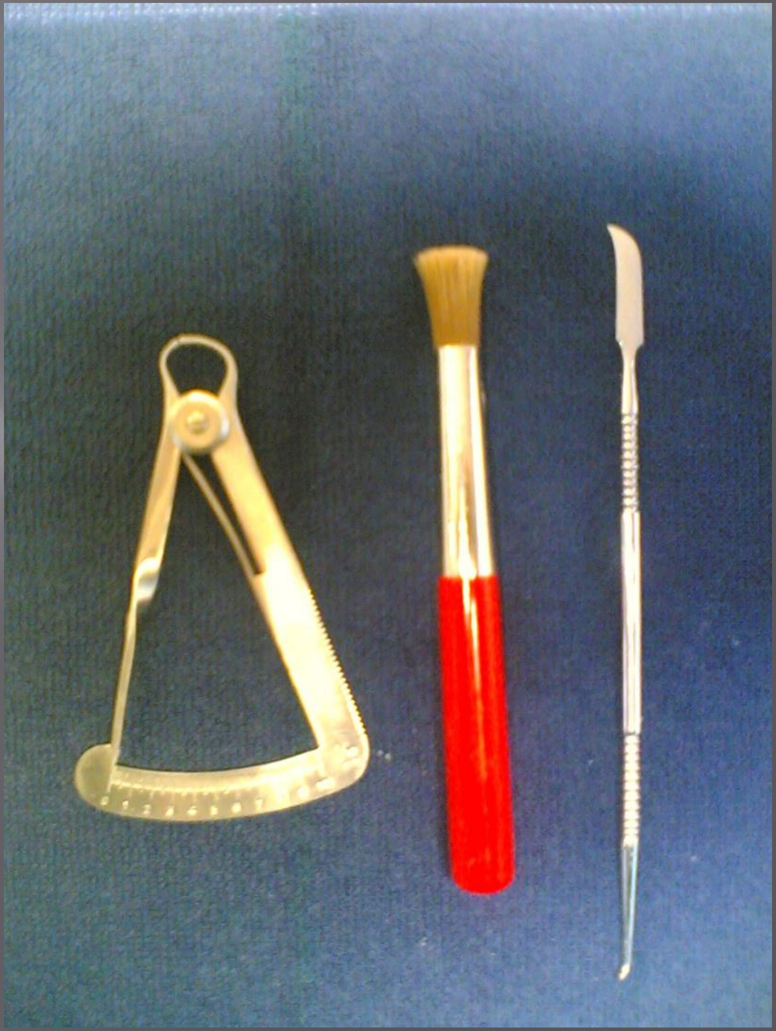
4- Separating liquid

5- Soft wax brush

6- Occlusal indicator powder
(zinc stearate).

7-Wax gauge (caliper)

8- Inlay wax.



Waxing Accessories

Calipers : for measuring thicknesses of wax

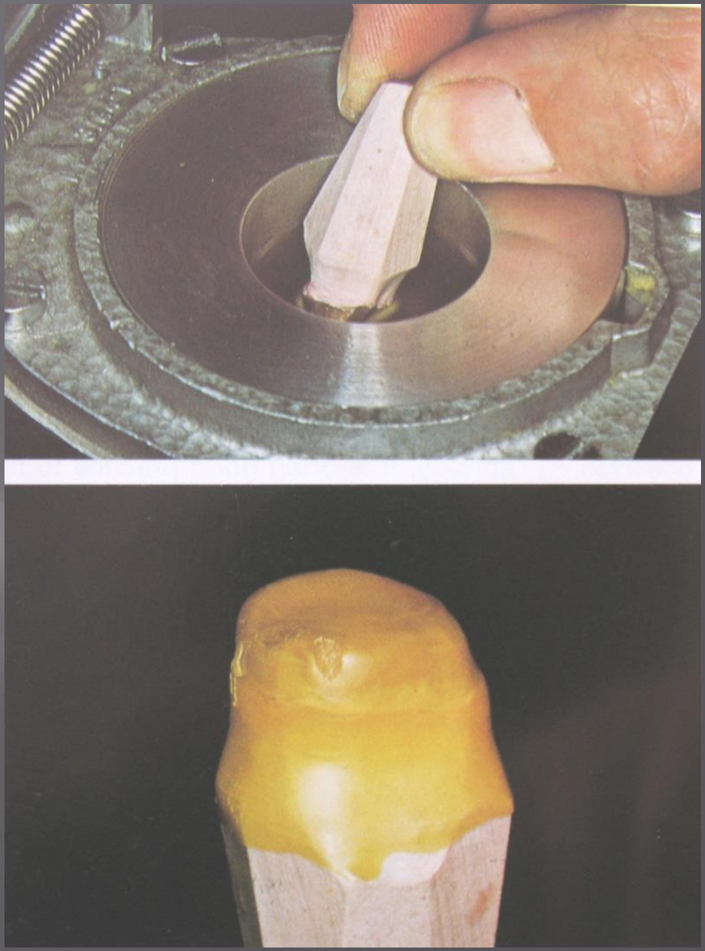
Margin Carver : carving margins of dipped wax copings

Different methods of wax pattern construction

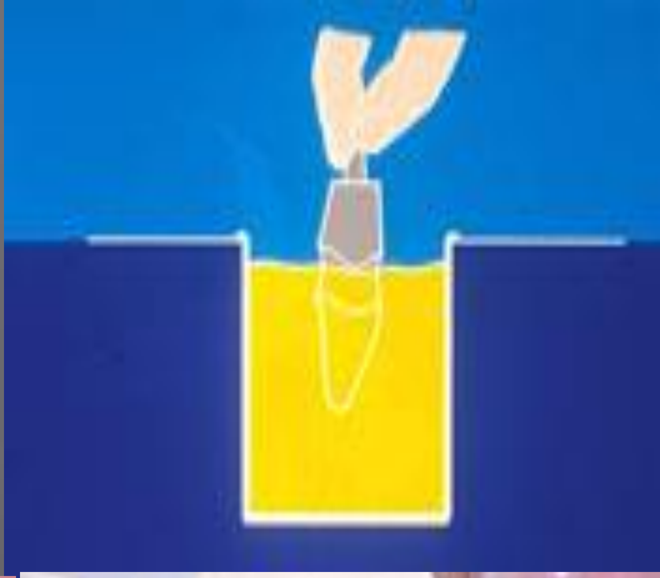
1- Dipping method :

To develop a thin uniform and adapted layer of wax on the die .

The die is dipped in a thoroughly melted wax in a wax dipping pot.



Dipping method



2- Addition method:

This is done by melting the wax and dropping it on the die using a heated instrument till completion of the pattern then the pattern is carved using sharp carver.

The main drawback of this technique is the *strain* collected in the pattern due to multiple addition of wax which will be released later on.

3-Molten press technique :

To assure better adaptation of the wax pattern finger pressure is applied to the molten wax after each application.

4-Injection method :

This method is used in research work and performed by injecting a molten wax in metal syringe into closed mold.

Injection method

Innovative wax injector designed with a self-contained air pressure system that maintains consistent pressure.

The built-in hand pump eliminates the need for an air compressor.

Waxing Guidelines

- Understand properties of wax:
  - Hard versus soft.
  - Distortion.
  - Shrinkage.
- Adding wax.
- Cleanliness:
  - Clean instruments.
  - No debris in the work area.

Waxing of posterior teeth:

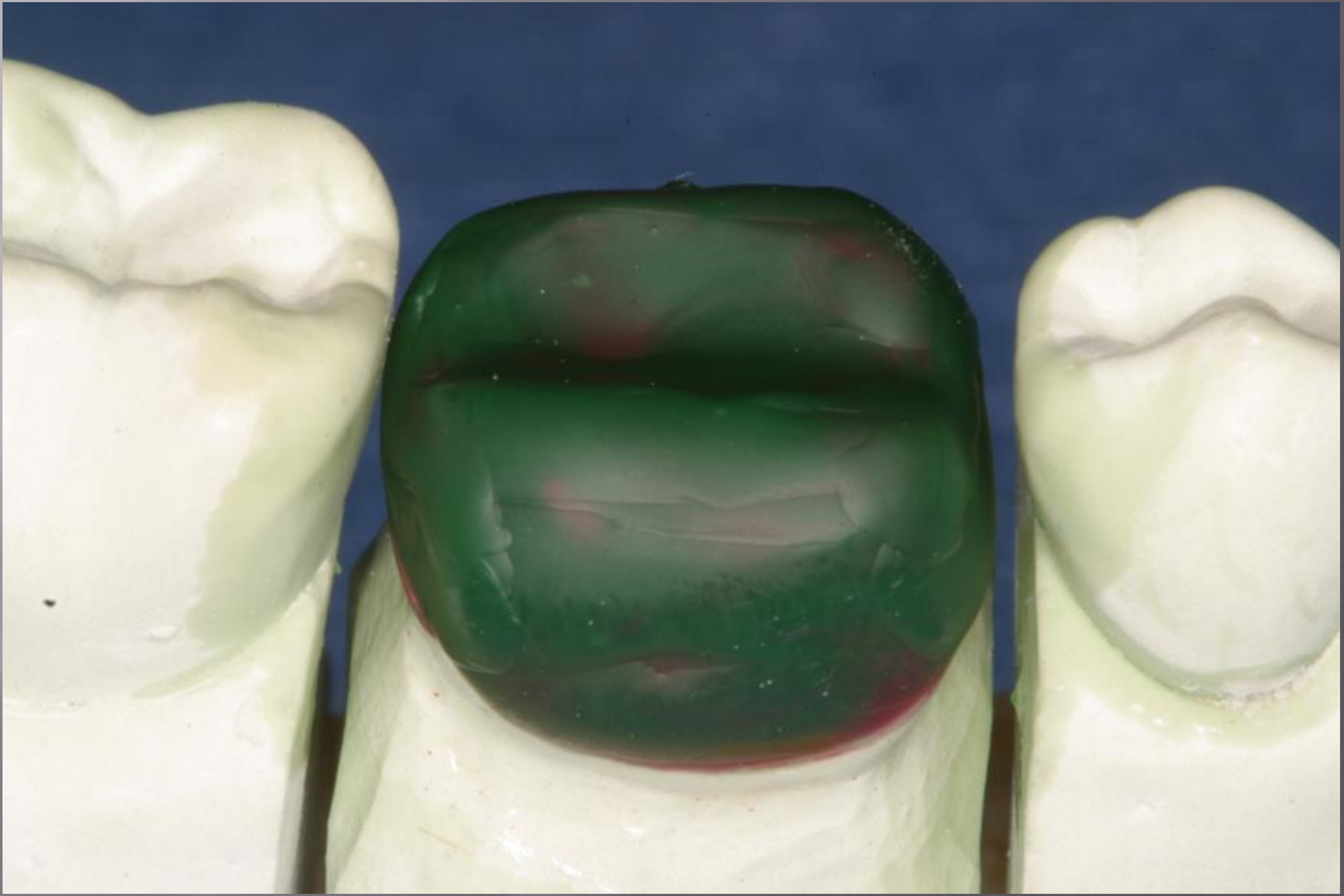
1. Internal surface.
2. Wax pattern removal.
3. Proximal surfaces.
4. Axial surfaces.
5. Occlusal surfaces.
6. Margin finishing.

Full Contour Wax-up

- Lubricate die, adjacent teeth and opposing teeth
  - Thoroughly remove excess with blast of air
- Fabricate coping
  - Wax beyond finish line-allow wax to cool.
  - Remove excess beyond finish line.
- Remove coping from die
- Examine coping with stereomicroscope
- Form proximal contacts & contours
- Develop occlusion

Coping Formation

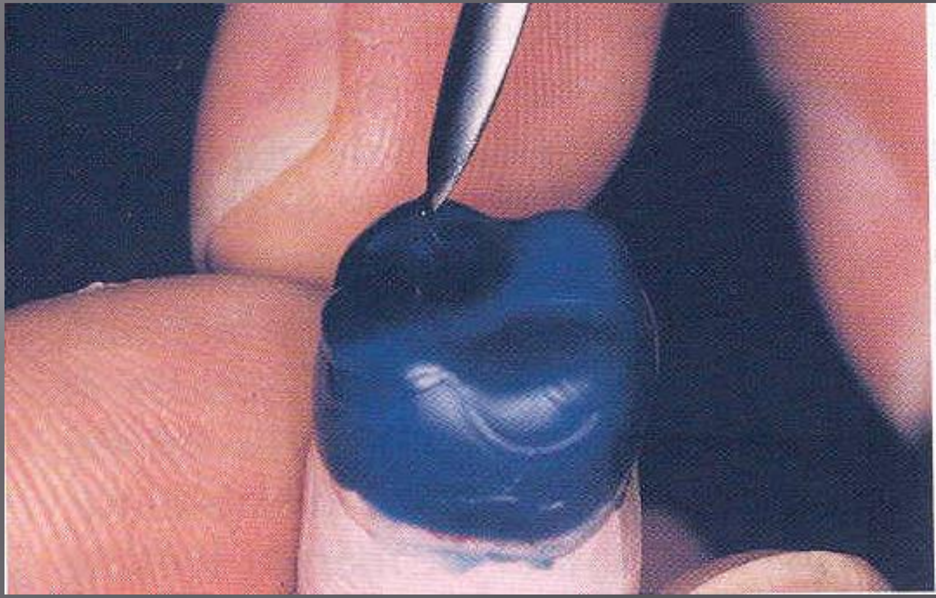
- Apply die lubricant:
  - Die
  - Adjacent teeth
  - Opposing teeth
- Apply wax to form coping
- Remove coping from die and inspect internal of pattern for completeness



Internal Surface (coping)

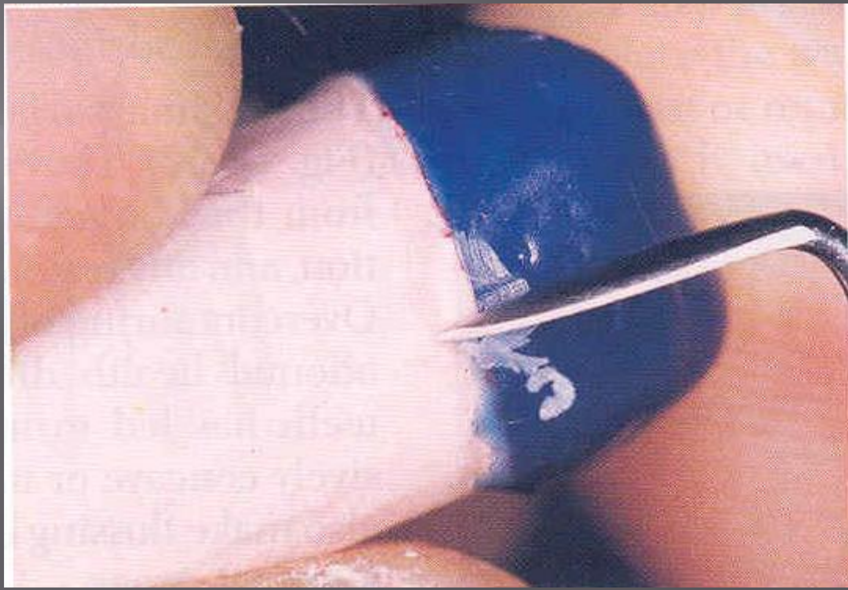
Step- by- step Procedure

Subsequent waxing of external anatomic details is accomplished with cooler instruments, which allows small additions to be placed accurately.



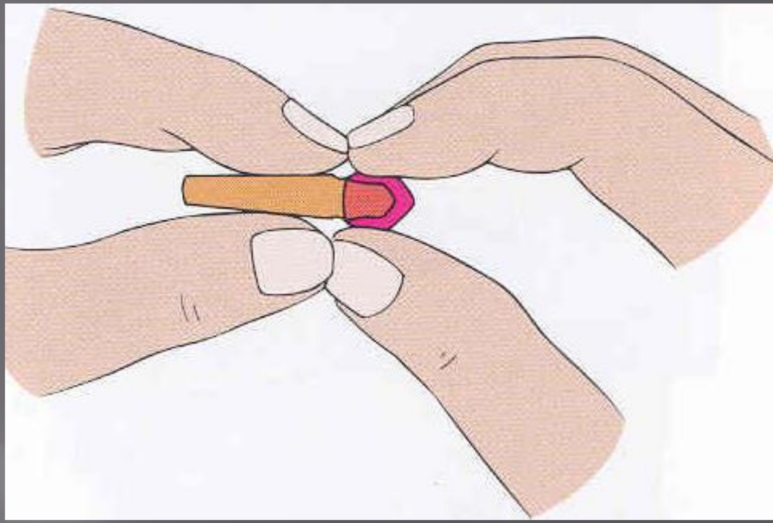
Give the proximal areas extra bulk to help grip the coping and prevent its distortion when it is removed from the die.

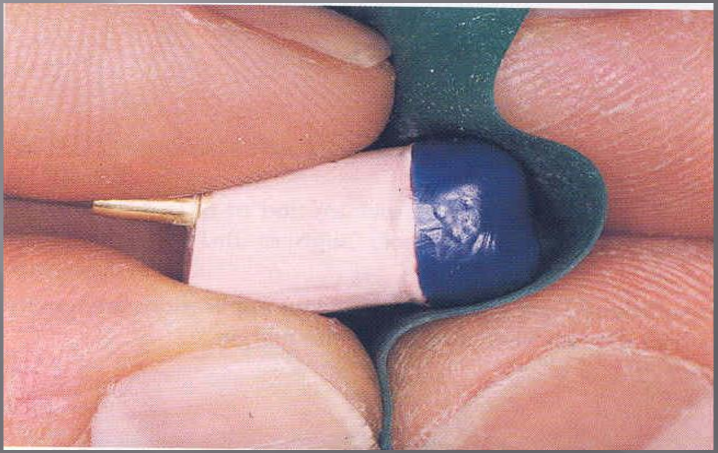
Trim the wax back to the margin so the coping can be removed and evaluated.

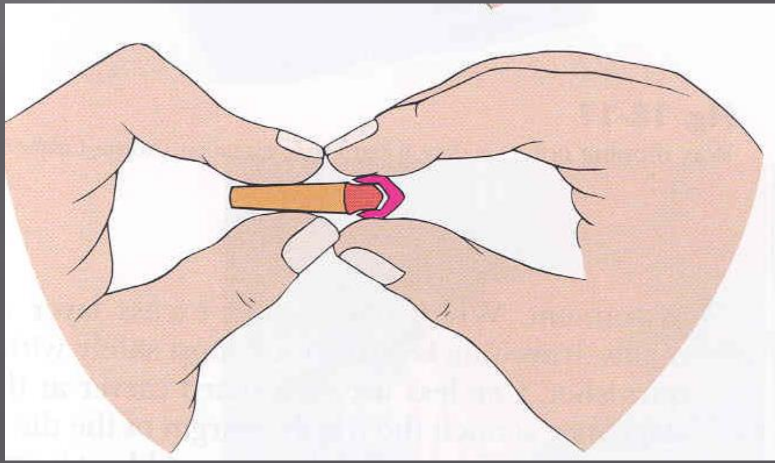


Wax Pattern Removal

A constant light grip is maintained on the pattern by the *thumb and forefinger* of one hand while pressure is applied against them with the thumb and forefinger of the other hand, which also holds the die

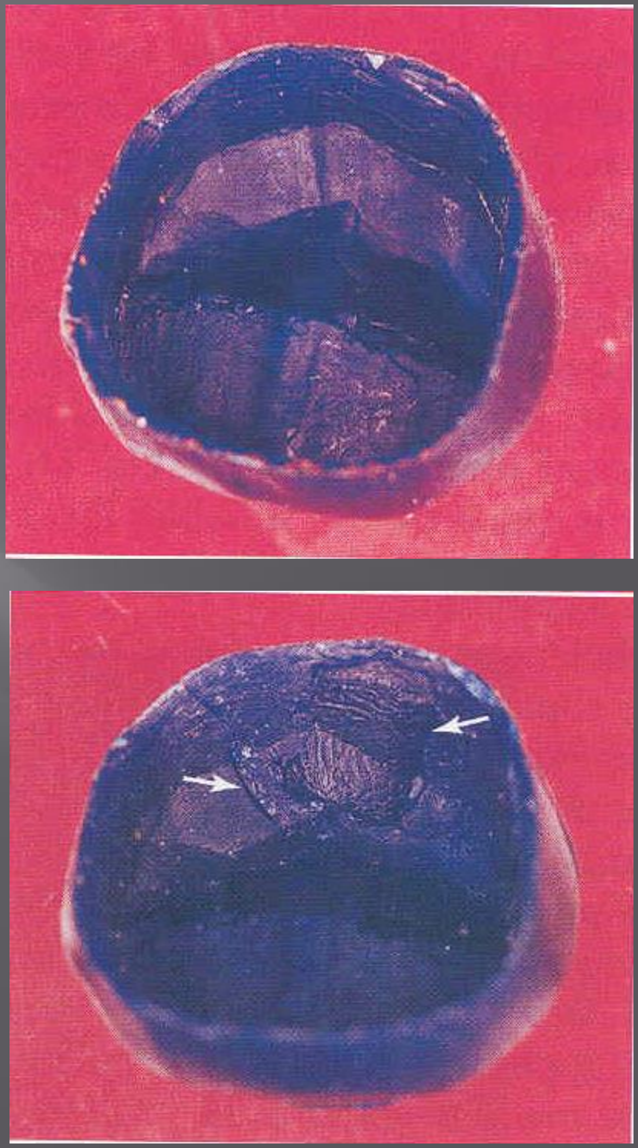






Evaluation:

- The examiner rotates the pattern under a bright light and looks for defects formed by folds or creases.



1x

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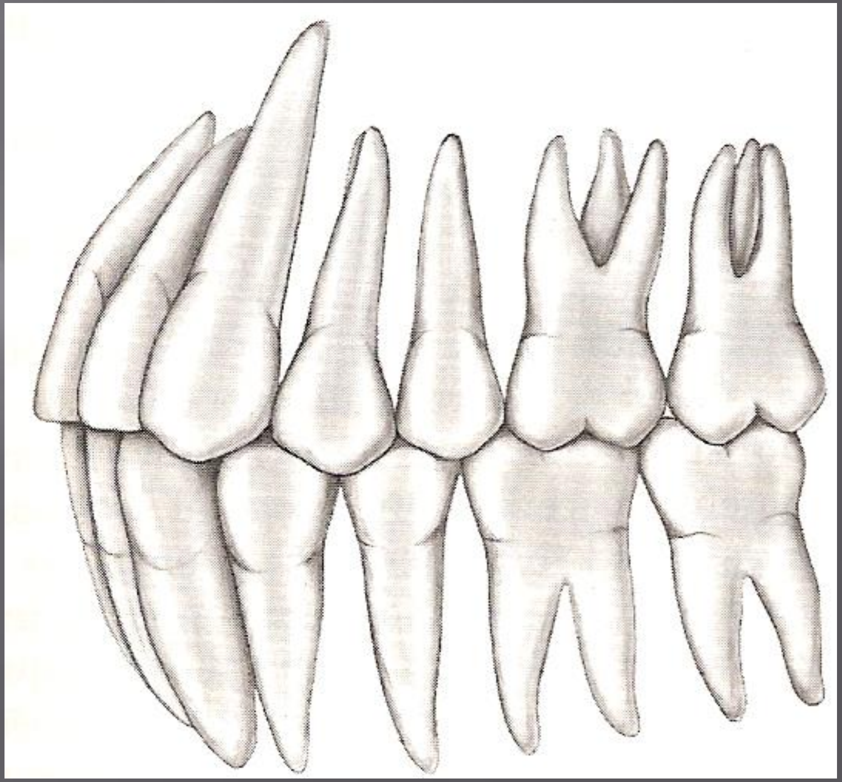
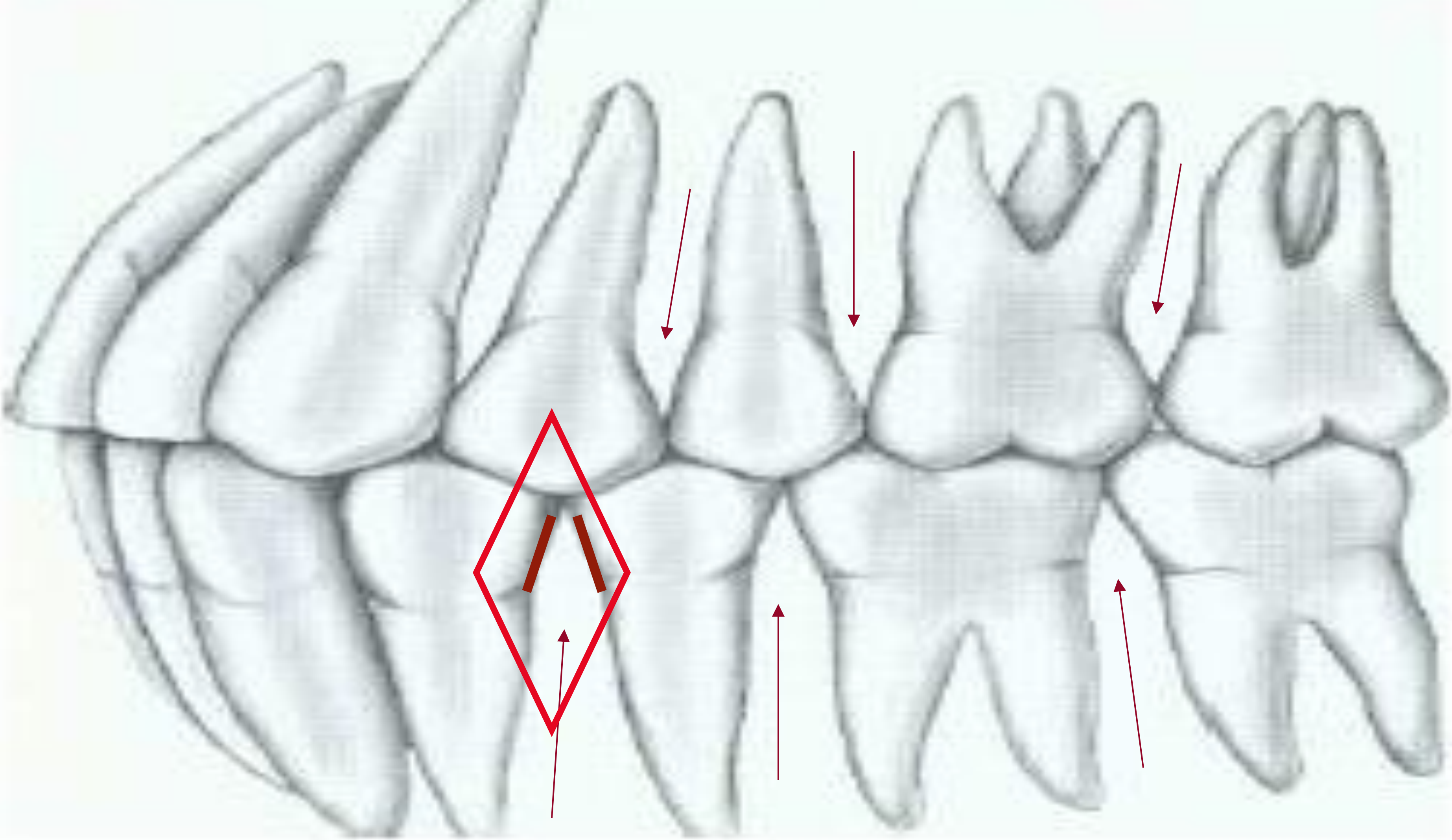
Proximal Surfaces

- Proximal surfaces gingival to the contact area are normally *flat or slightly concave* from the contact area to the CEJ and any restoration must reproduce this feature.





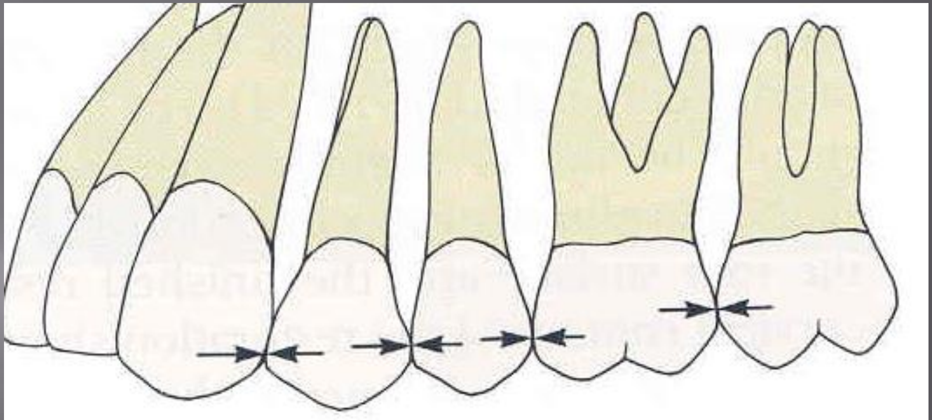
Proximal surfaces gingival to the contact area are normally flat or concave. Note the triangular shape of the posterior embrasures.

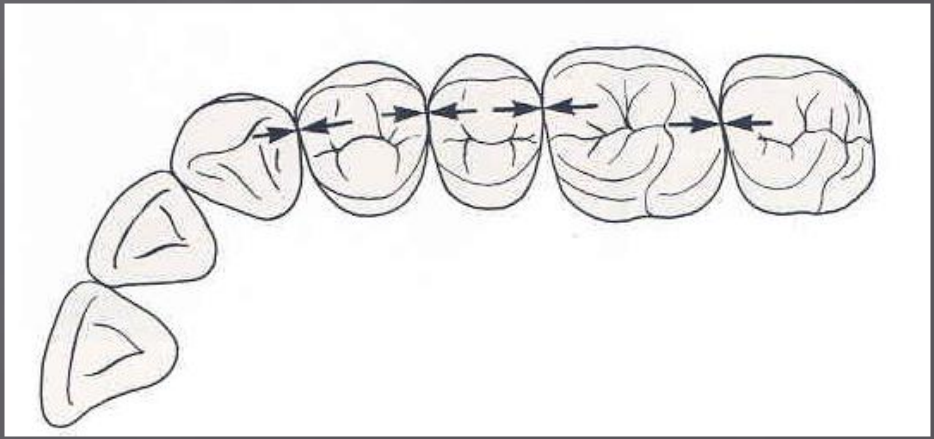
Characters of the proximal surfaces

Most posterior contact are located ***in the occlusal third*** of the crown.

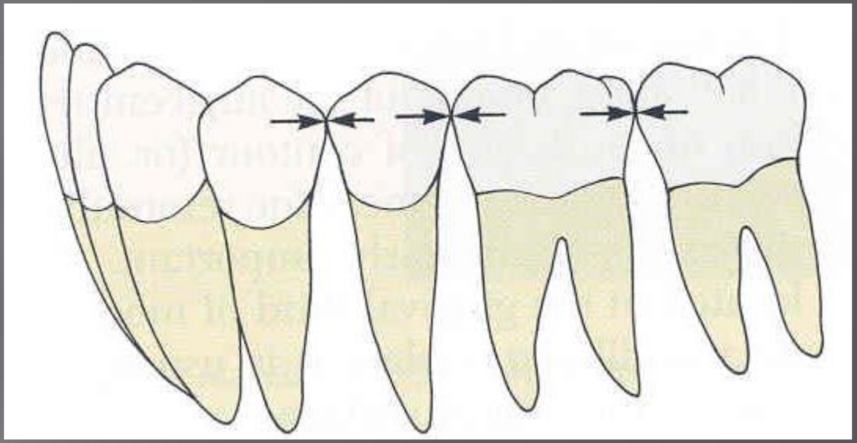
Between maxillary premolars and molars, the contact areas are usually ***toward the buccal*** surface making the lingual embrasure larger than the buccal.

Contact between the maxillary first and second molar occurs ***in the middle third.***

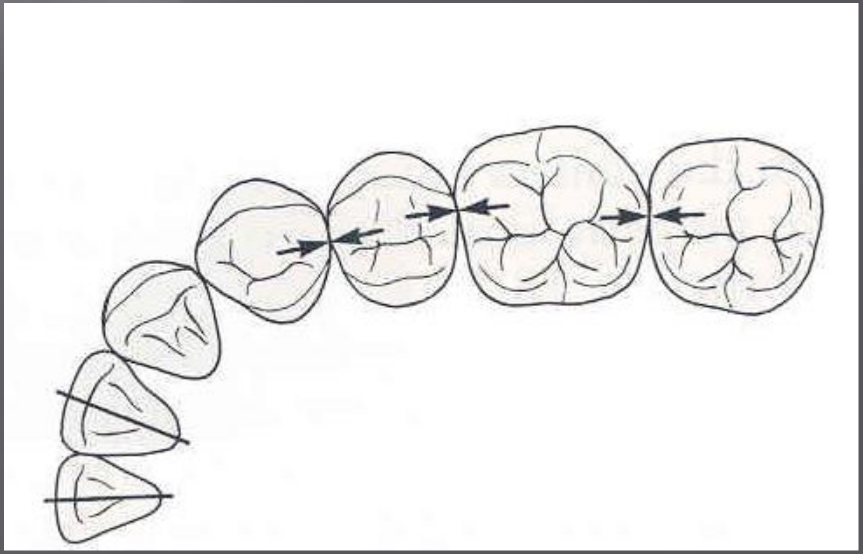




The contact areas between mandibular teeth and maxillary molars are generally *centrally located*.

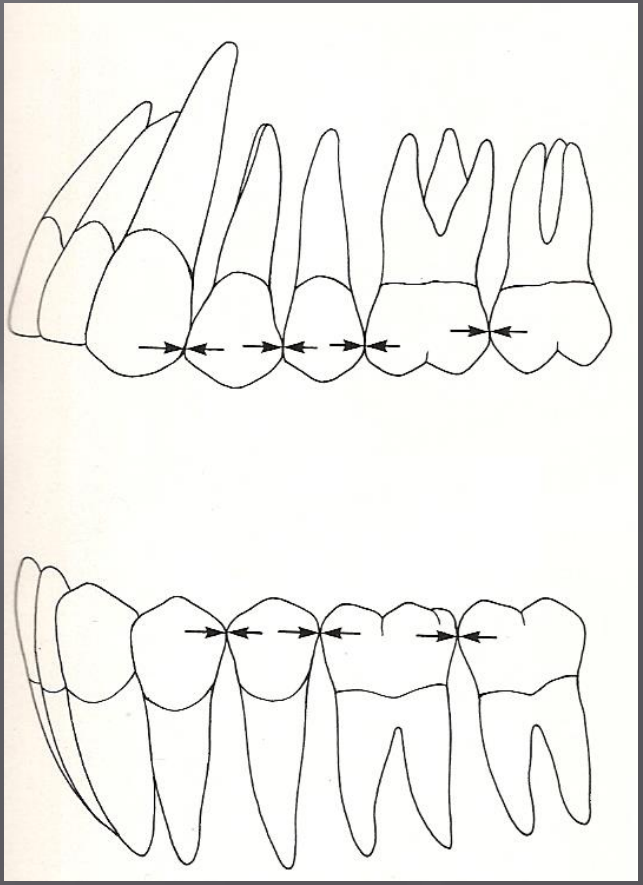


Contact areas between mandibular teeth are generally *centrally located*.

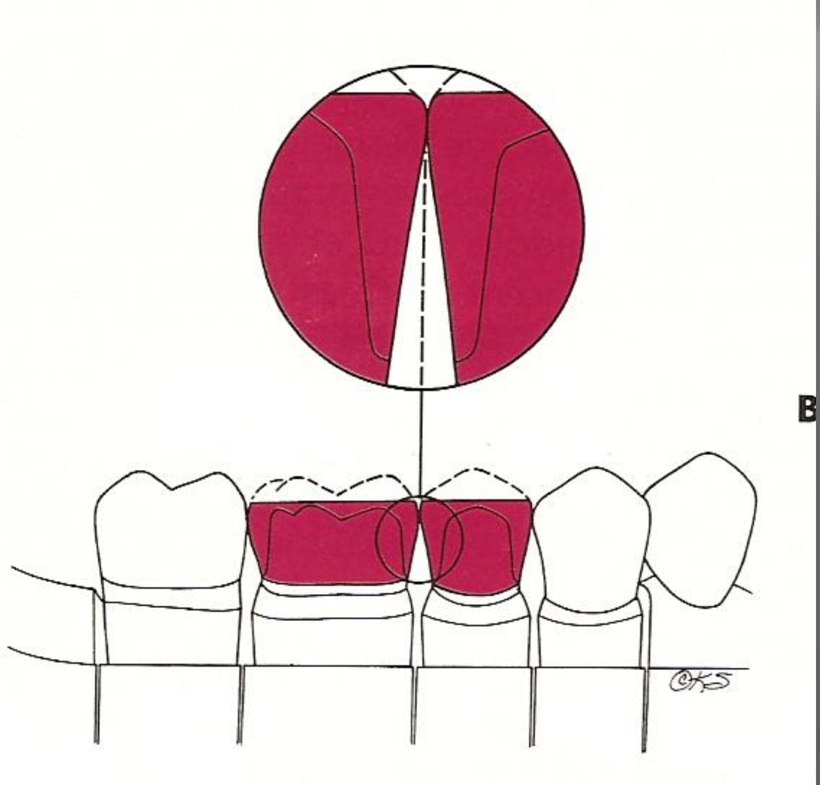


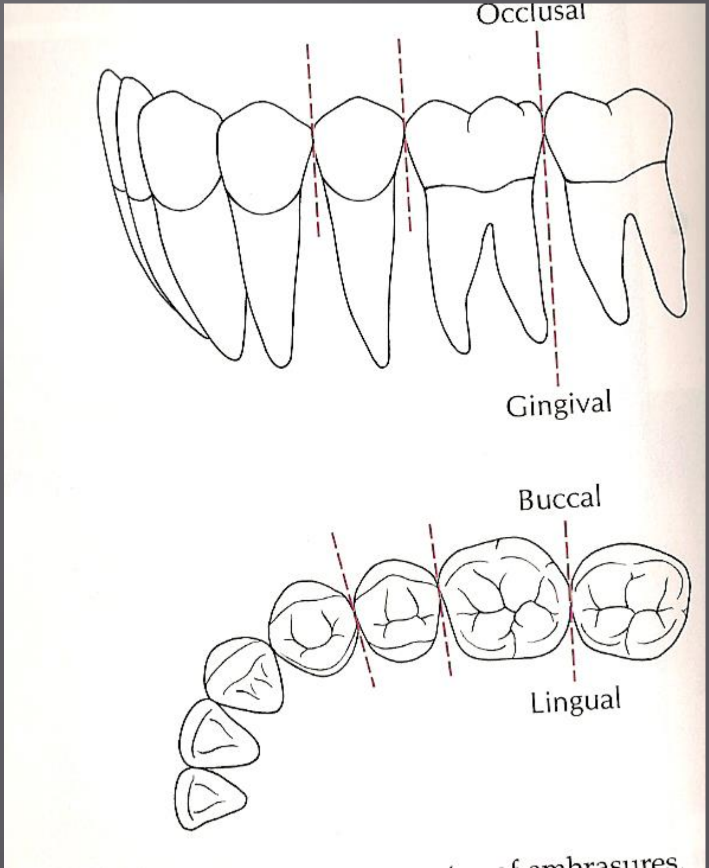
Contact areas

- The size shape and location of the contact area should be established before waxing the remainder of the proximal surfaces.
- Usually in the occlusal third of the crown except for the contact between maxillary first and second molar where it occurs in the middle third.



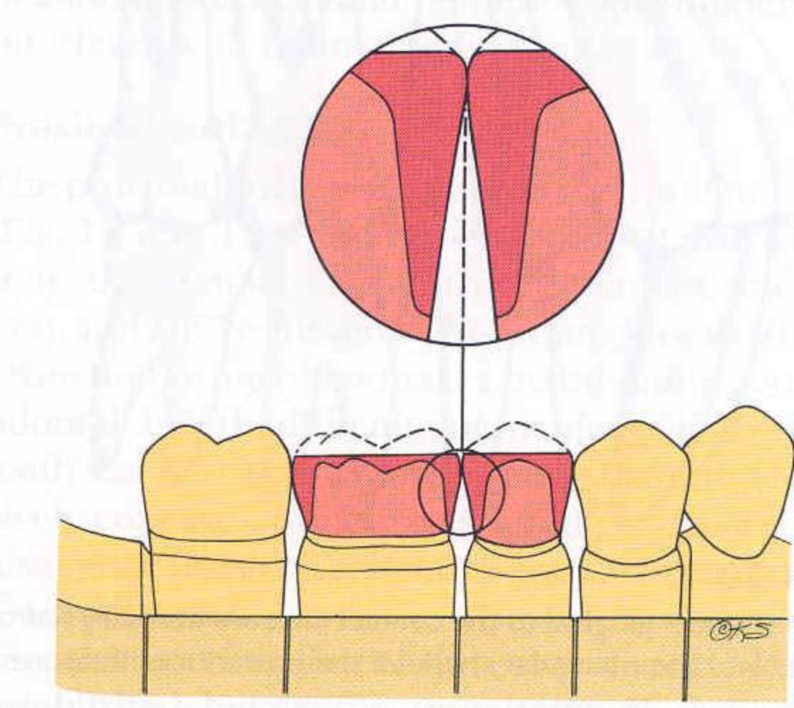
- The contact areas should be shaped so that the gingival embrasures are *symmetric*.

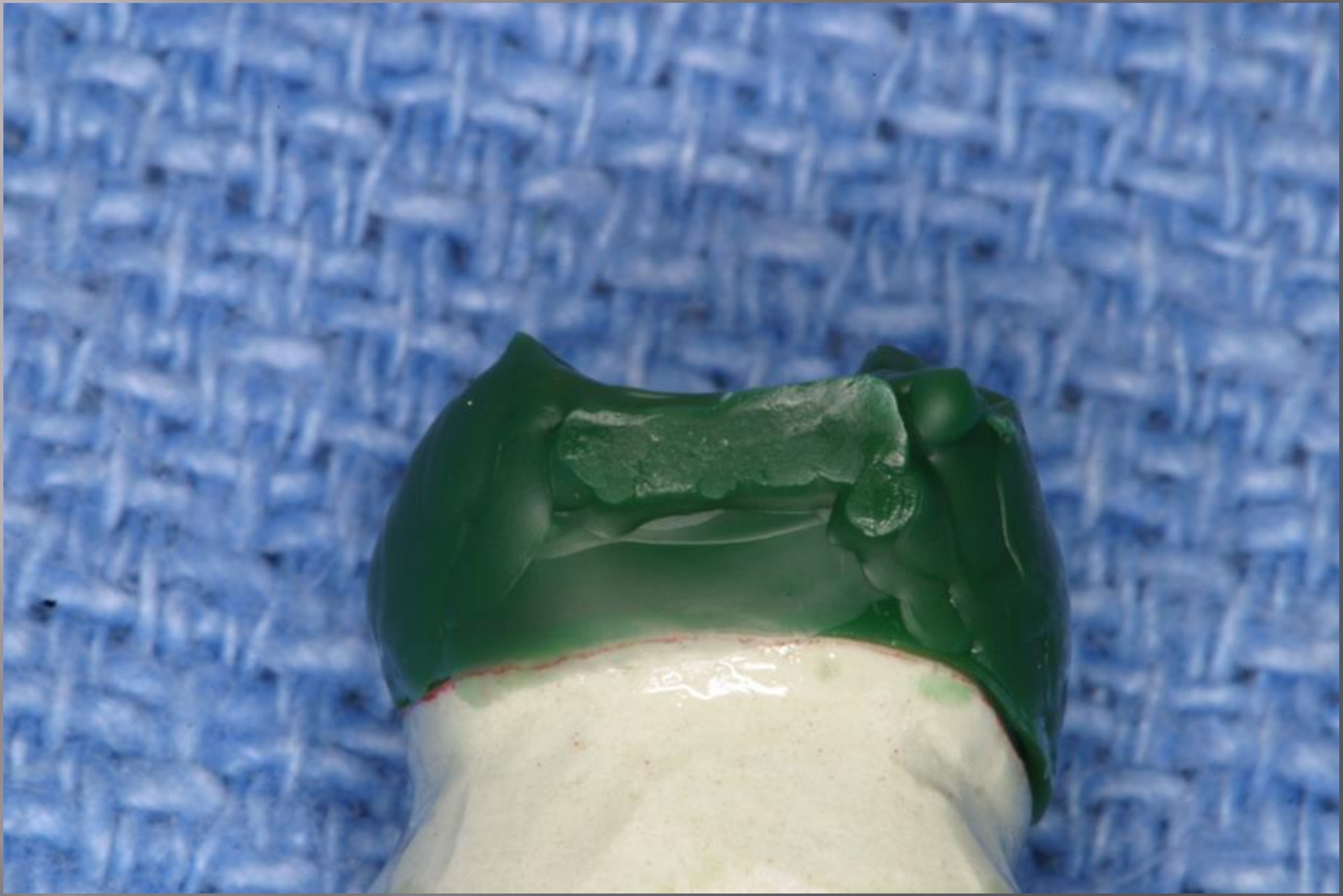


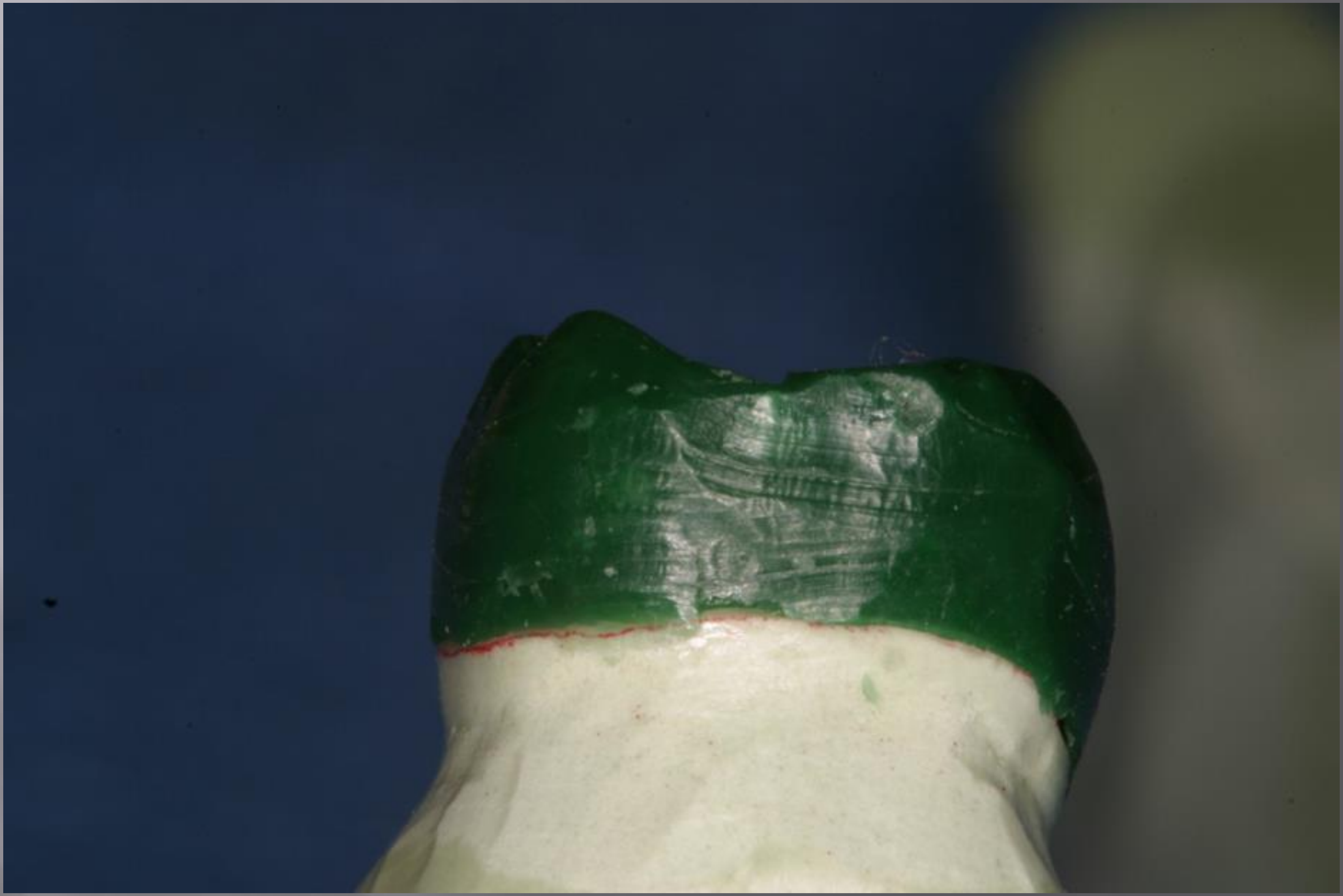


Where multiple restorations are being made, the proximal embrasure is shaped symmetrically to provide adequate room for the free gingival tissues of adjacent teeth

The cervical contour of the restoration should be continuous, with the contour of the unprepared tooth structure immediately cervical to the preparation margin.

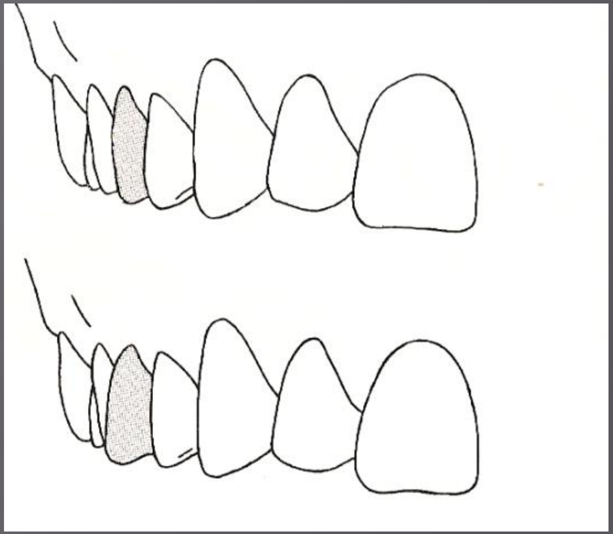


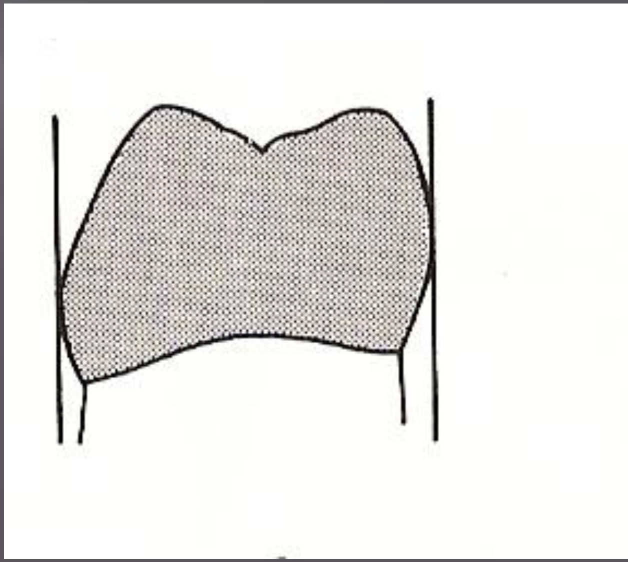




Axial Contours

- Buccal and lingual surfaces should be shaped following the contours of the adjacent teeth.
- The position of the height of contour is generally located *in the gingival third* of most teeth.
- Teeth are rarely more than *1 mm* wider at their height of contour than at the CEJ.
- In mandibular molars, it is located in the middle third of the lingual surface.





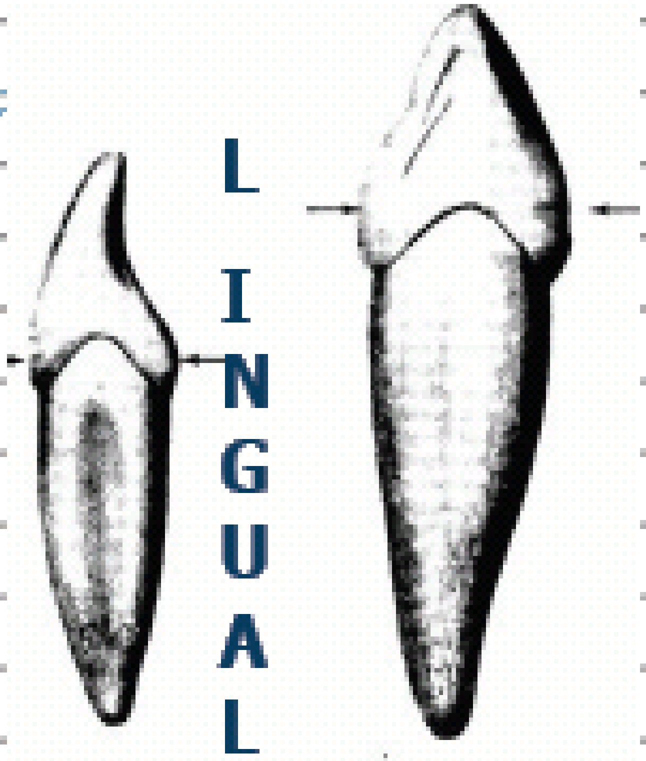


Fig. 22-7. Labial and lingual heights of curvature of mandibular and maxillary incisors and canines are located within the cervical thirds of teeth. Facial and lingual crests of curvature *(arrows)*. Also notice the curvature of the cervical lines (CEJ). (From Zeisz RC, Nuckolls J: *Dental anatomy,* St. Louis, 1949, Mosby.)

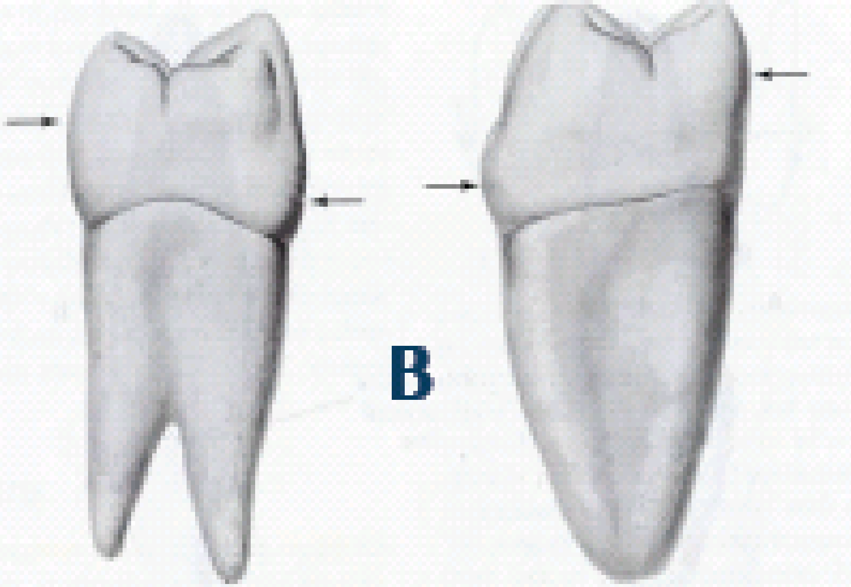


Fig. 22-8. The buccal height of curvature is at the cervical third, and the lingual height of curvature is at the middle third on the maxillary and mandibular premolars and molars. Buccal and lingual crests of curvature *(arrows)*. Notice the curvatures of the cervical lines (CEJ). (From Zeisz RC, Nuckolls J: *Dental anatomy,* St. Louis, 1949, Mosby.)

Height of contour: cervical 1/3

Buccal height: Cervical 1/3

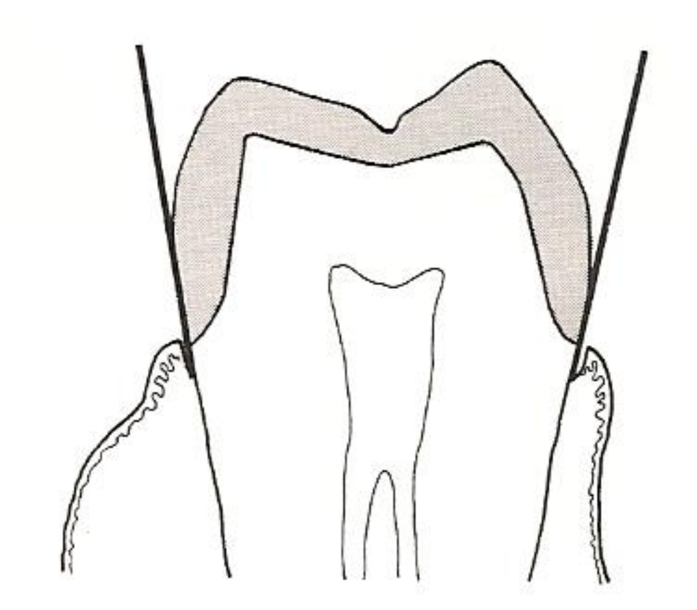
Lingual height: Middle 1/3

Emergence Profile

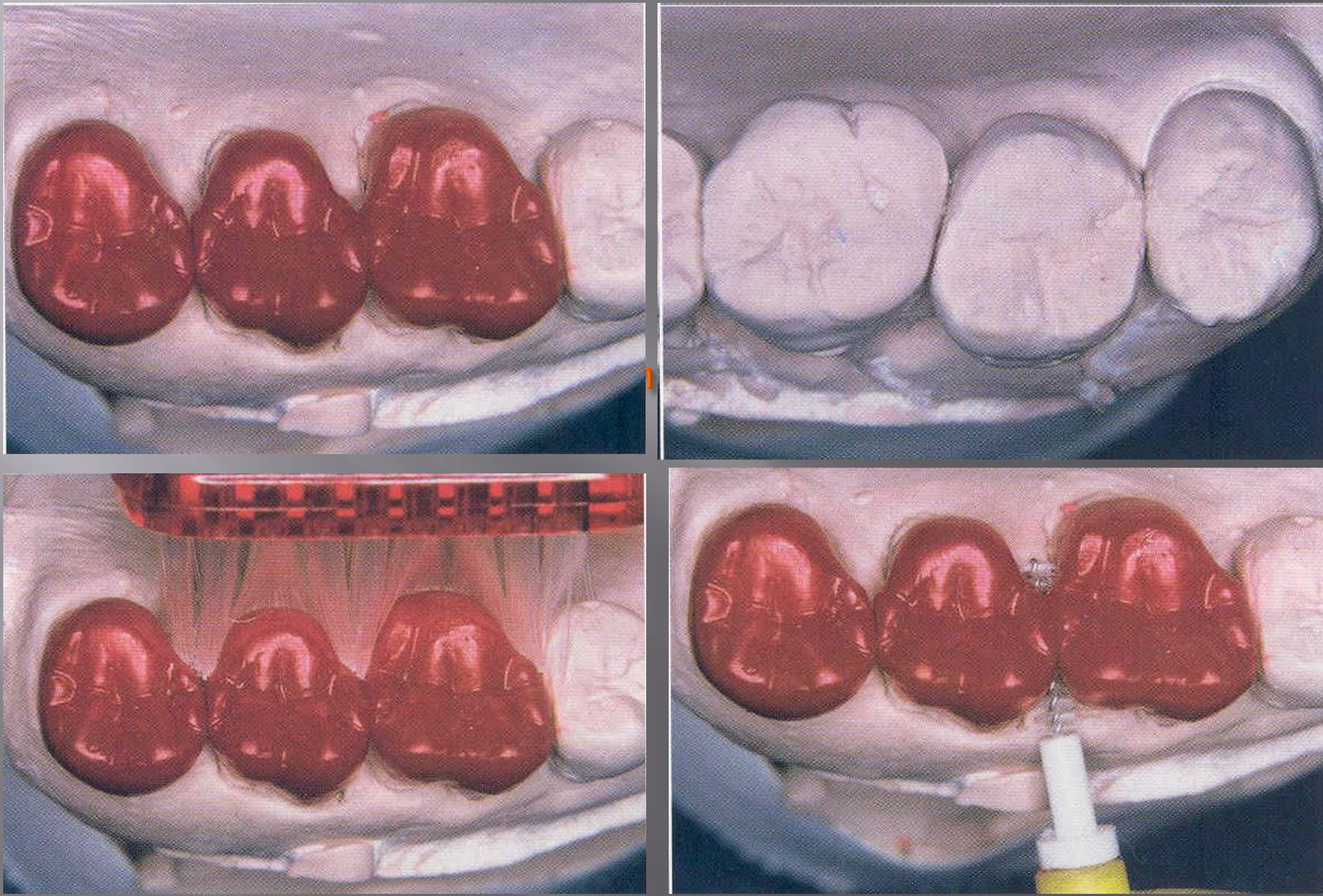
- *Def.* The tooth surface gingival to its height of contour immediately adjacent to the gingival soft tissues

- *Shape:* should produce a straight profile.

- *Significance:* creation of a convexity in this area makes bacterial plaque removal very difficult and causes inflammatory and hyperplastic changes in the marginal gingiva.



- Therefore, ***emergence profile*** should be a treatment objective in restoring a tooth.



Occlusal Surface

Characters of the **occlusal** surface

1-The cusps and ridges of the occlusal surfaces should be shaped to allow *even contact* with the opposing teeth while stabilizing the teeth and directing forces along their long axes

2-Noncentric or nonfunctional cusps of the maxillary and mandibular teeth should *overlap vertically and horizontally*, preventing accidental biting of the cheek or tongue and keeping food on the occlusal table.

3- *Point contacts* between opposing teeth are preferred to broad, flat occlusal contacts

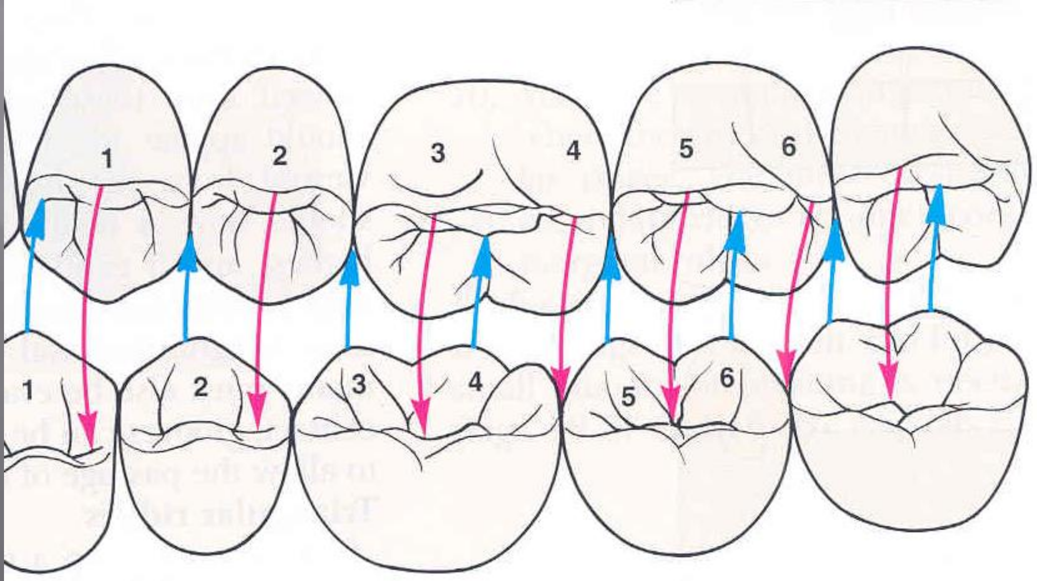
The occlusal surfaces of natural teeth consist of a series of *convexities* with developmental grooves where the convex ridges meet.

Occlusal Scheme:

Two occlusal schemes are generally recognized

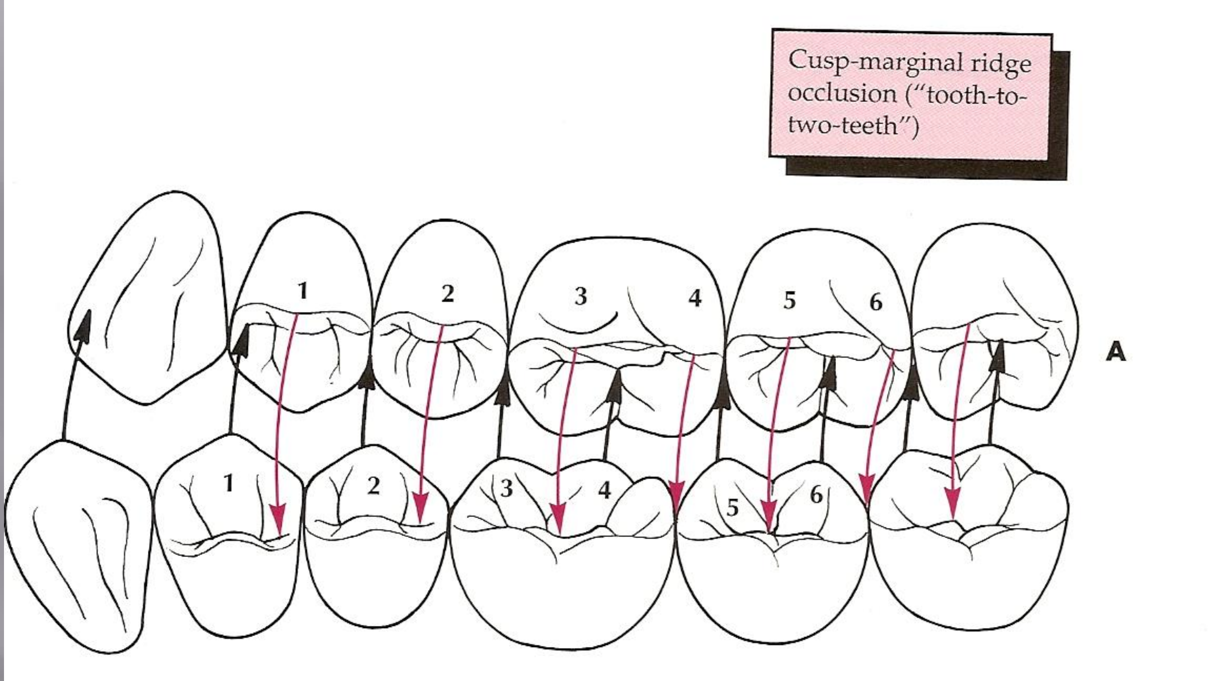
1- Cusp- marginal ridge

The buccal cusps of the mandibular premolars and the mesiobuccal cusps of the mandibular molars contact the embrasures between the maxillary teeth



1- Cusp-marginal ridge

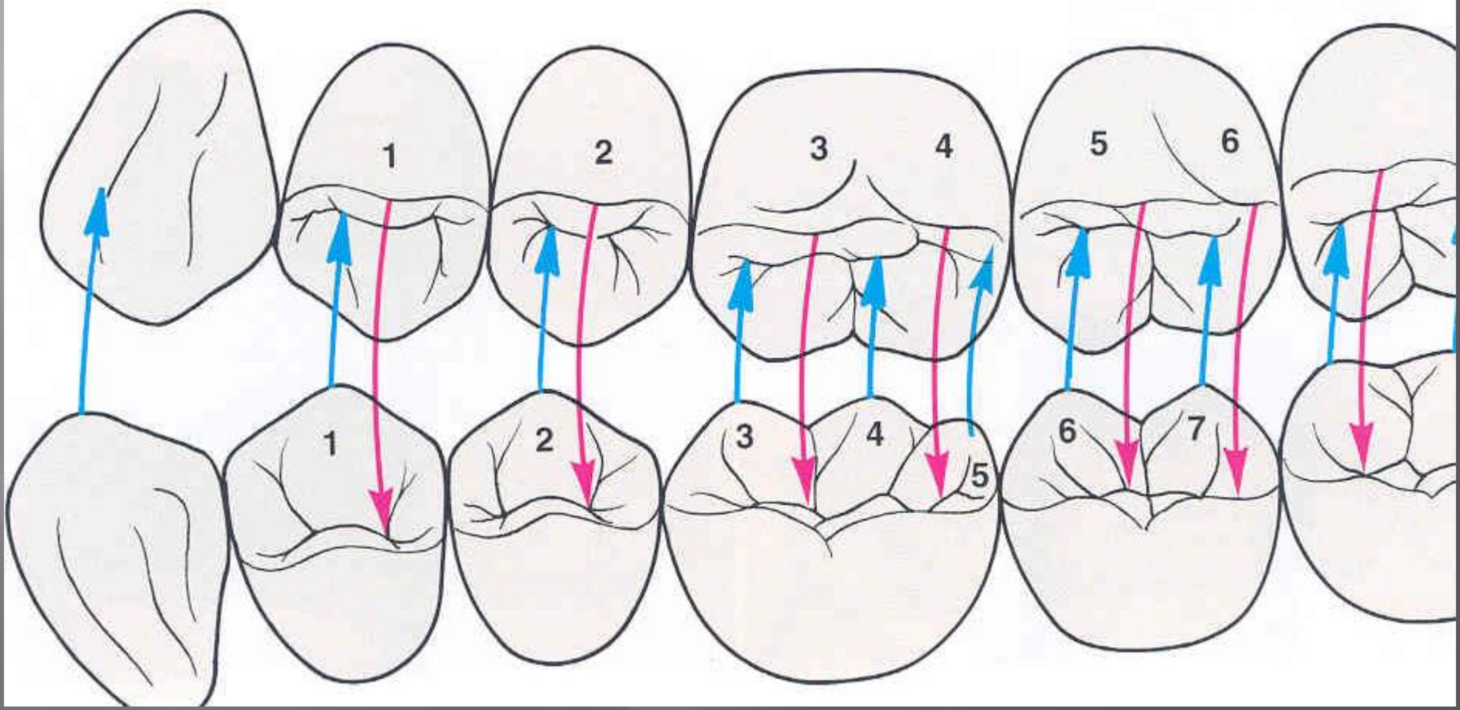
Tooth-to-two-teeth arrangement



- In which, the functional cusps (buccal cusps in mandibular and palatal cusps in maxillary) contact the oppsing occlusal surfaces on the marginal ridges of the opposing pair of teeth.

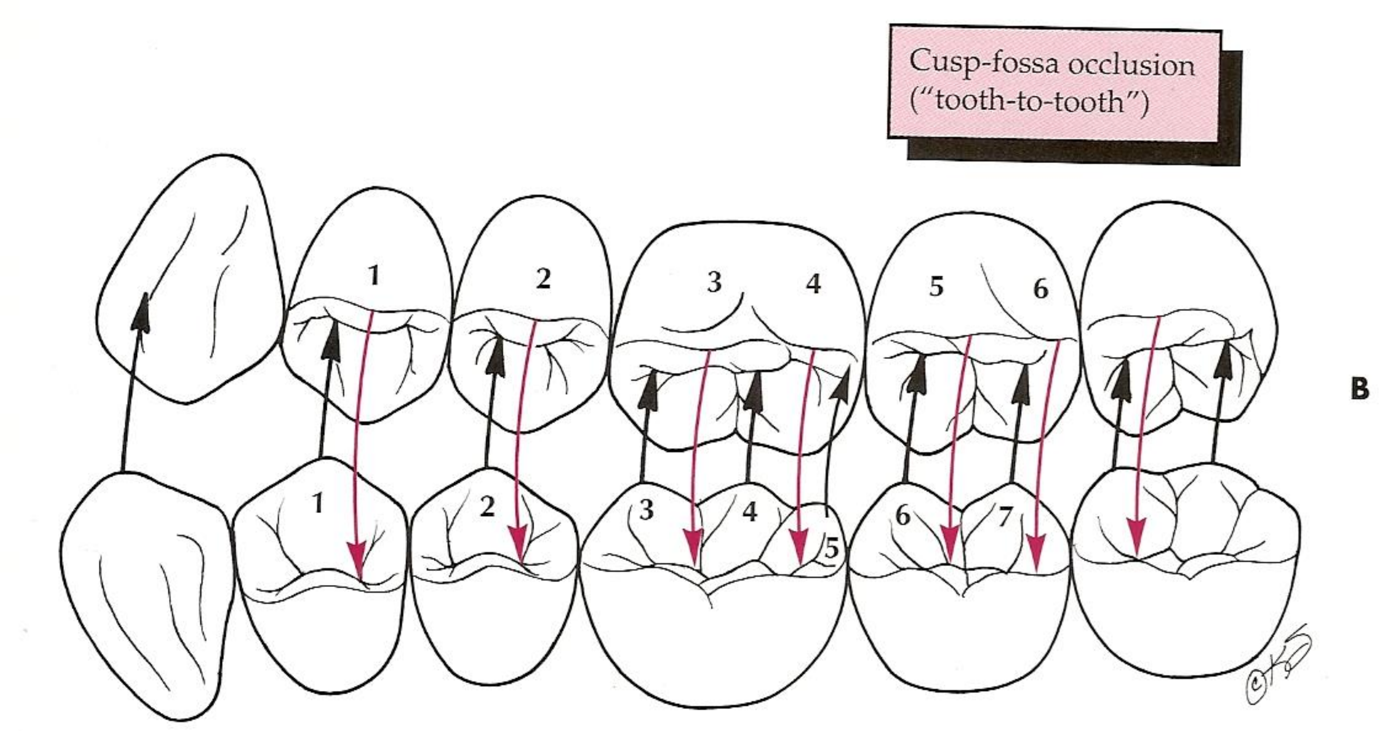
2- Cusp- fossa scheme:

Mandibular centric cusps contact farther distally into the fossa of the maxillary teeth



2- Cusp-fossa

Tooth-to-tooth arrangement



- In which, the functional cusps occlude in the occlusal fossa of the opposing teeth.

Most adults with a Class I occlusion and unworn teeth will have a cusp- marginal ridge scheme.

In natural dentitions, the cusp- fossa arrangement is found only when a slight Class II malocclusion is present.

Occlusal Scheme.

When the mesiodistal relationships of opposing teeth favor it, the cusp- fossa scheme is optimal because;

1. Food impaction is prevented.
2. Centric relation closure forces are nearer the long axes of the teeth.
3. Improved stability results from the tripod contacts for each centric cusp.

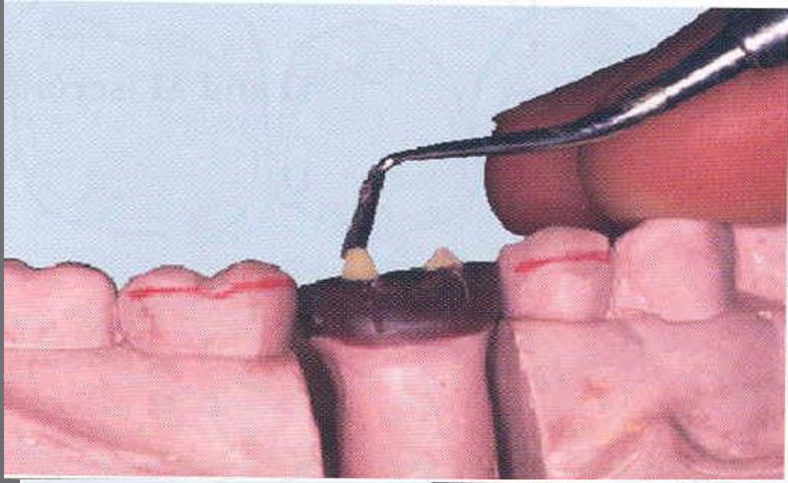
Step by step procedure

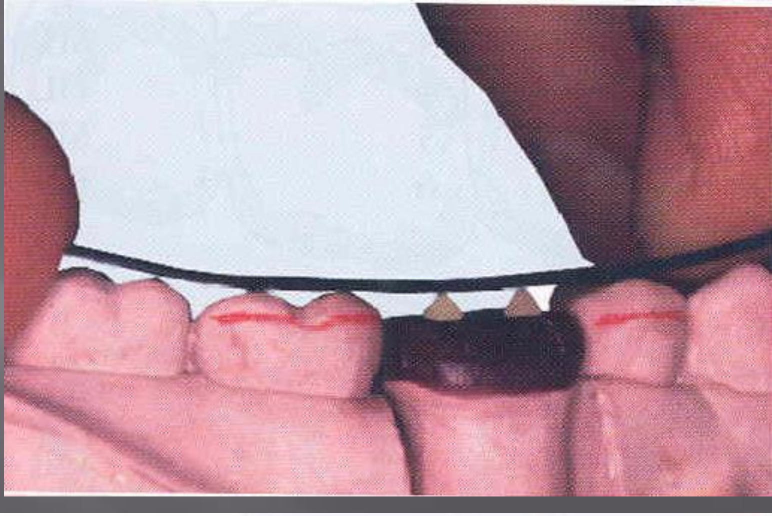
Cusp Height and Location

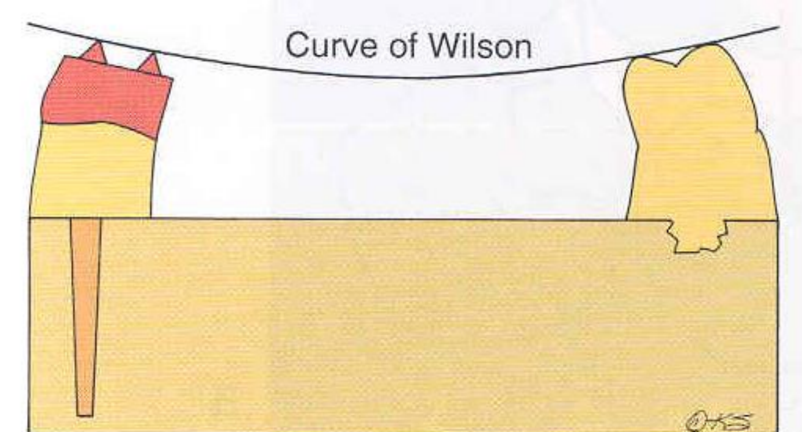
1. Determine the position and height of the cusps with wax cones.

2-The cones should be Positioned so they follow an anteroposterior curve *(the curve of Spee)*

They should also follow a compensating plane *(the curve of Wilson)* when viewed from the front.

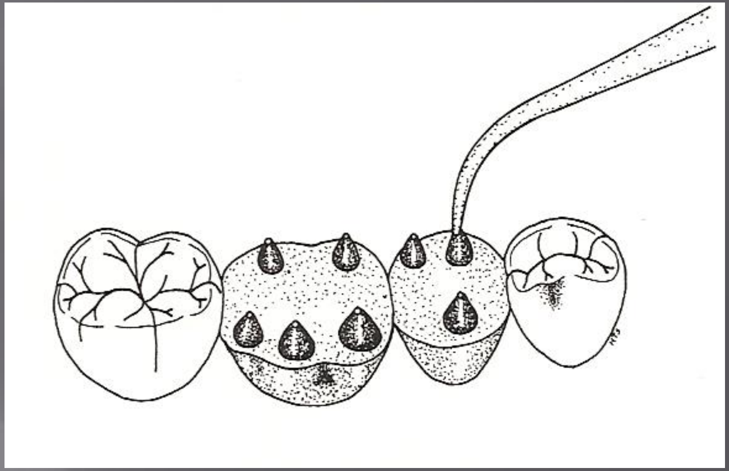


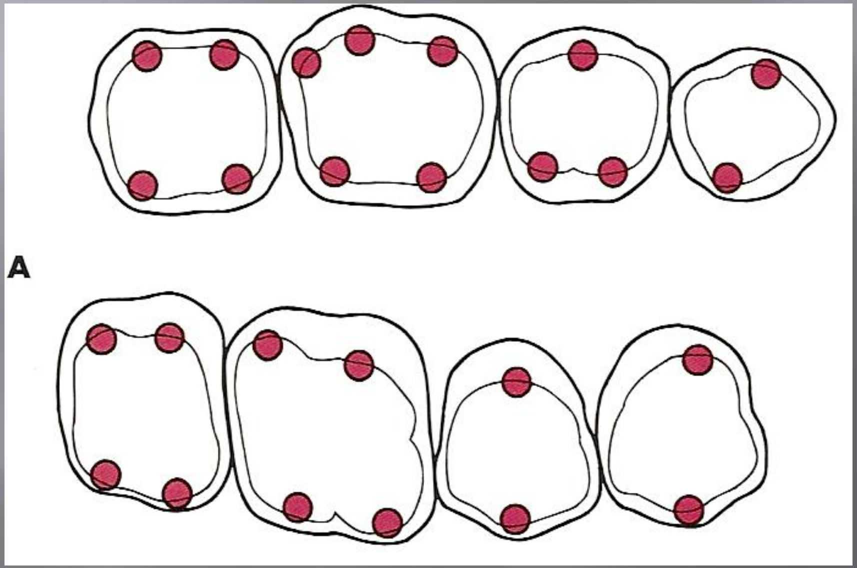


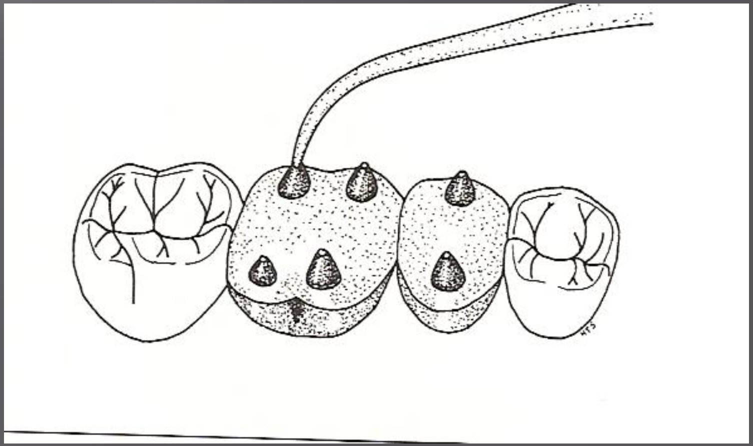


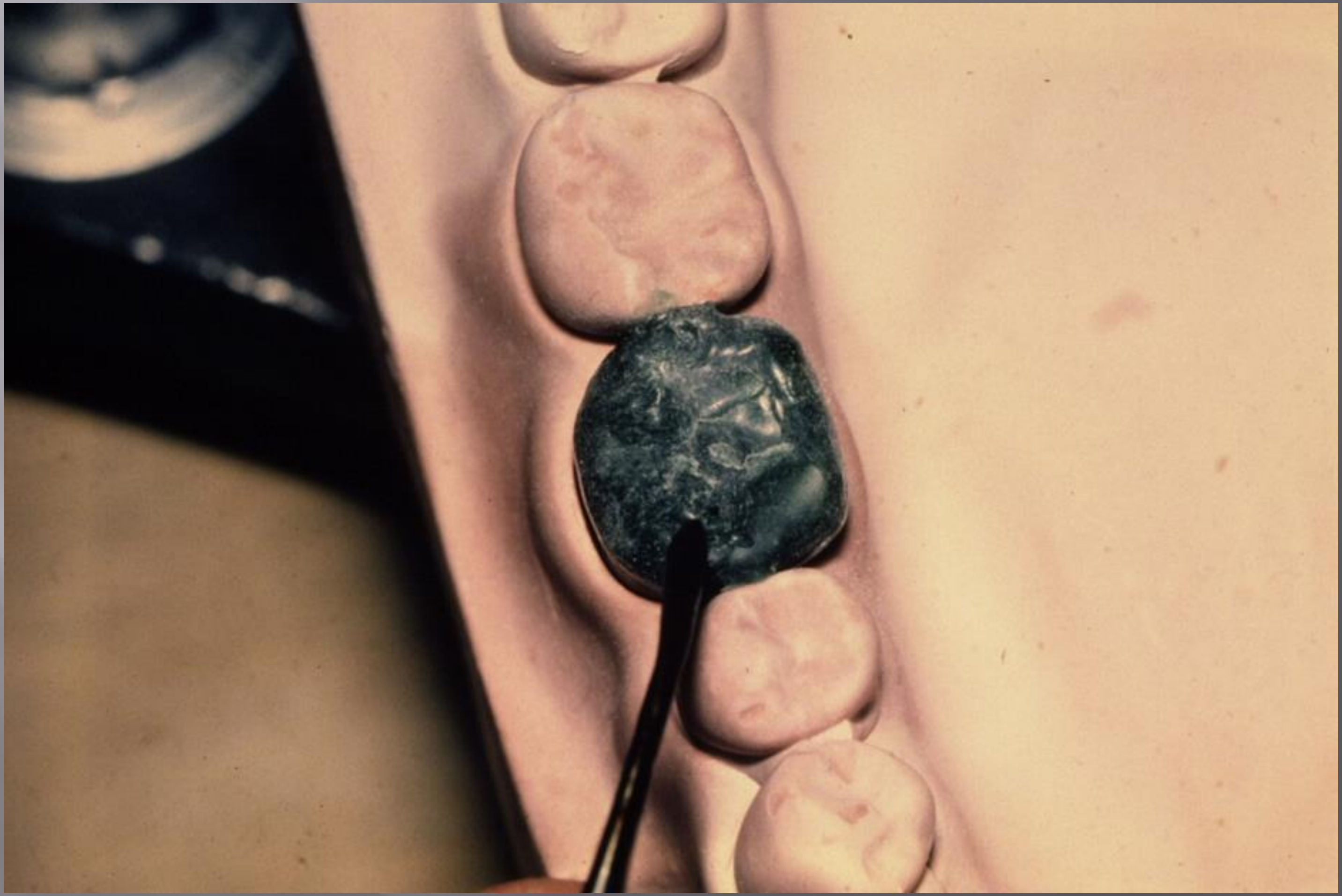
Waxing up the occlusal table

- 1-Cone Placement.



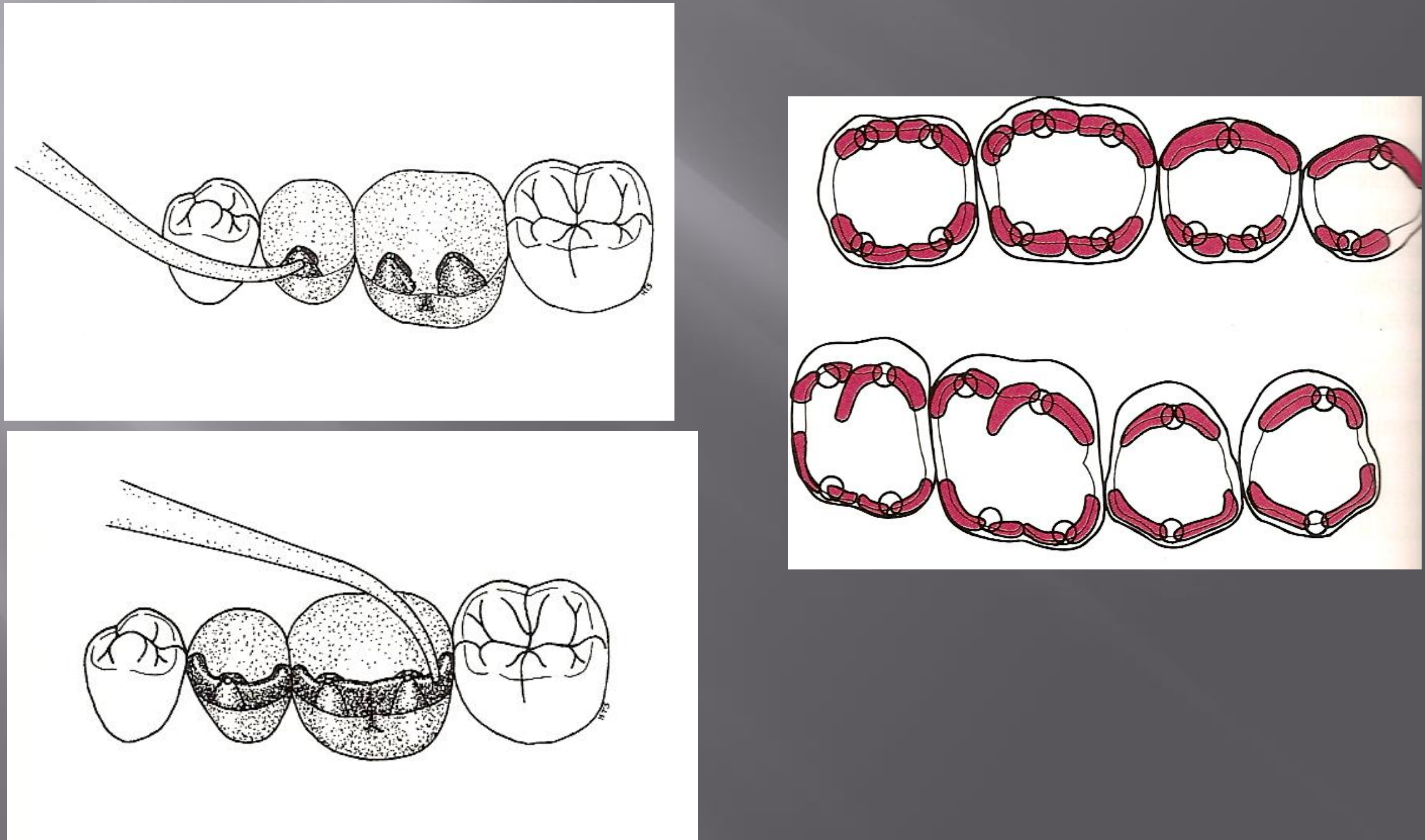




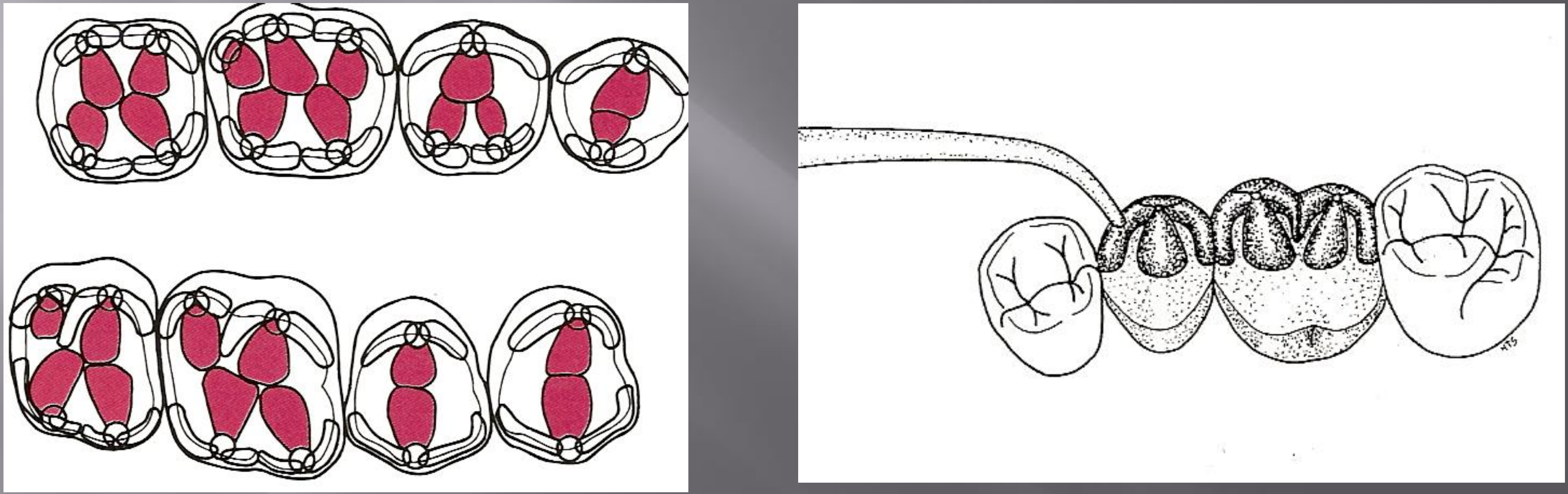


- **2-Cuspal ridges** are then superimposed:

  buccal, mesial and distal cusp ridges.



3- Triangular ridges are then added

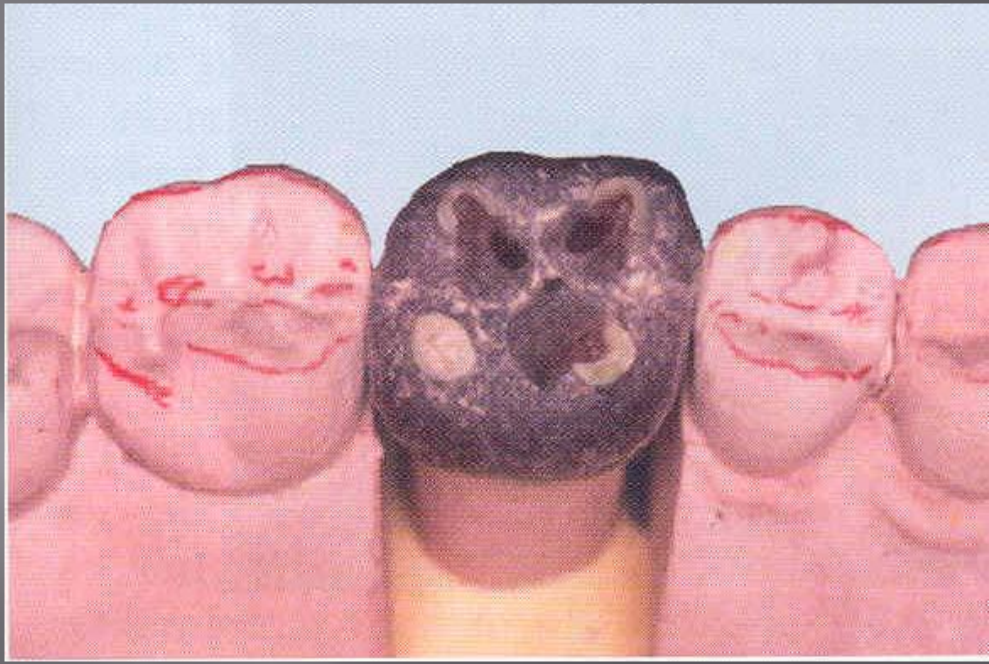


Cones, cuspal ridges and triangular ridges.

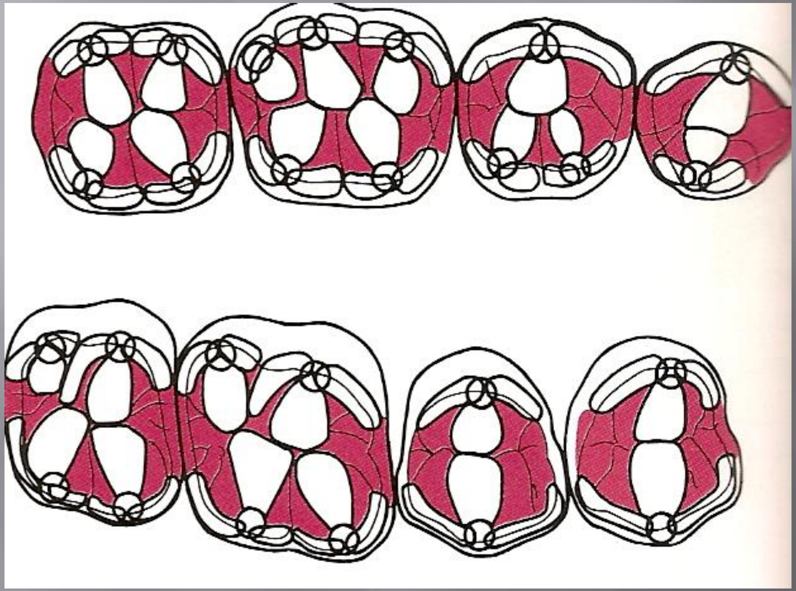
Triangular Ridges

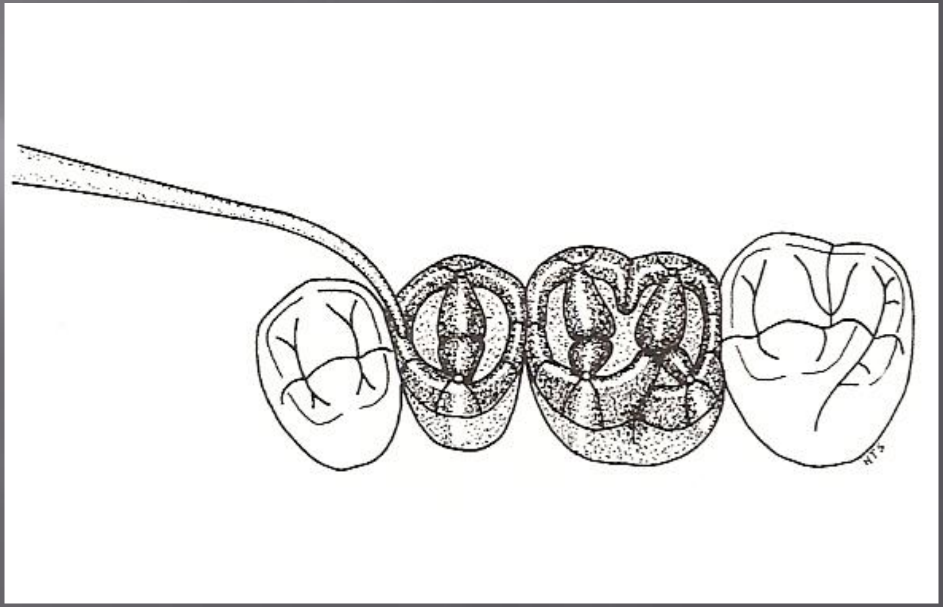
Give each cusp a triangular ridge that runs toward the center of the occlusal surface.

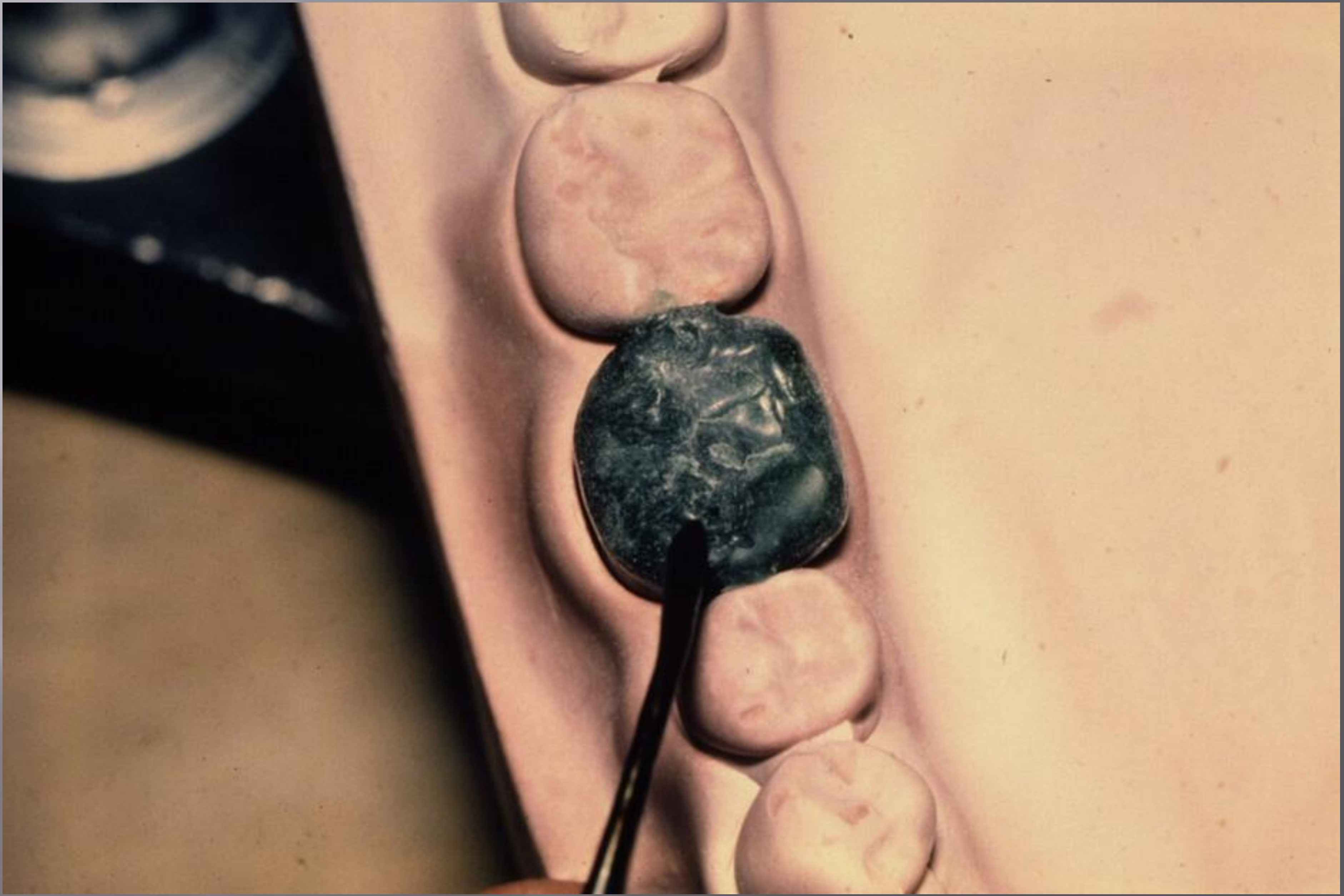
The apex (or point) of the triangle should be at the cusp tip, and the base should be in the center of the occlusal surface.

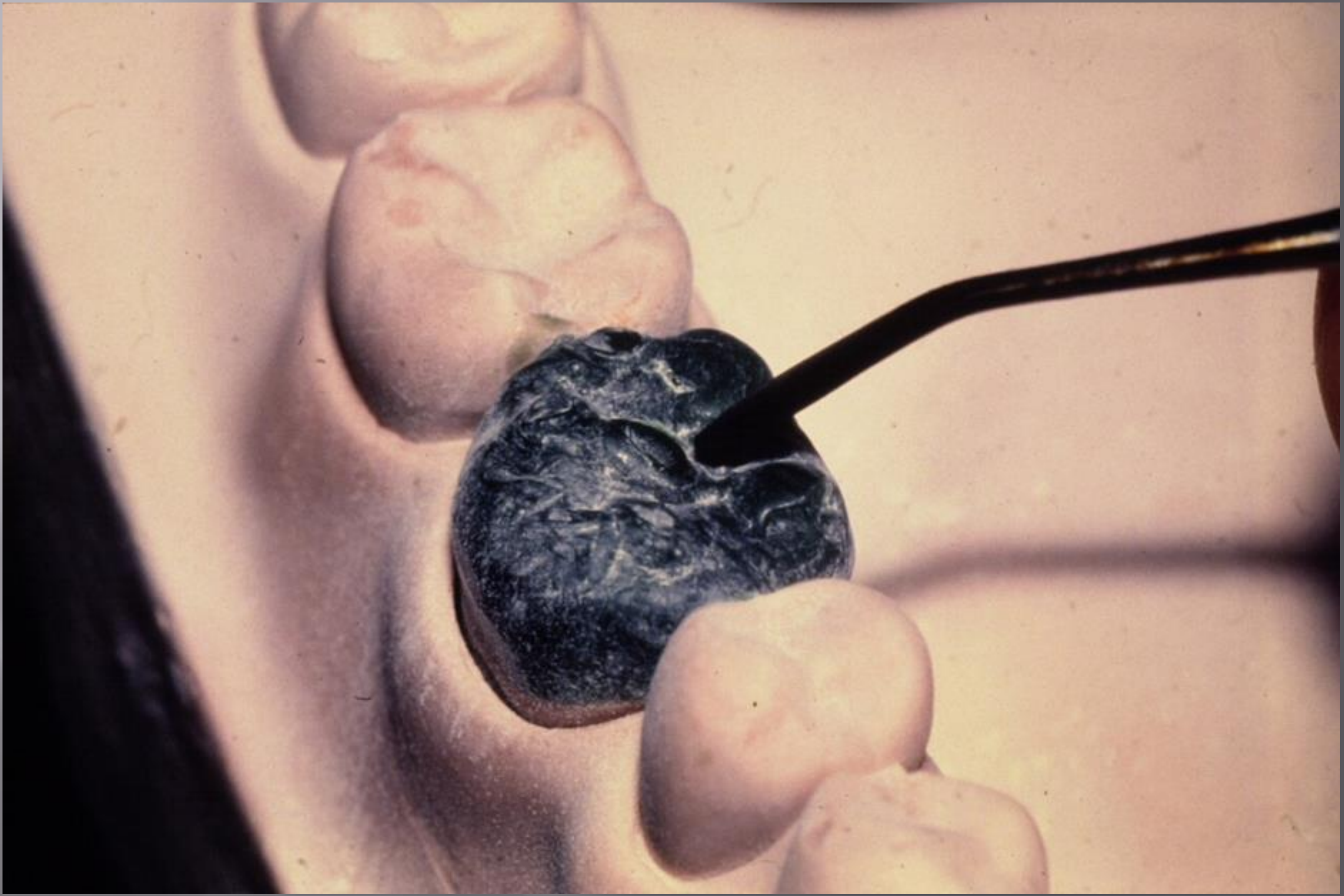


4-Marginal and secondary ridges



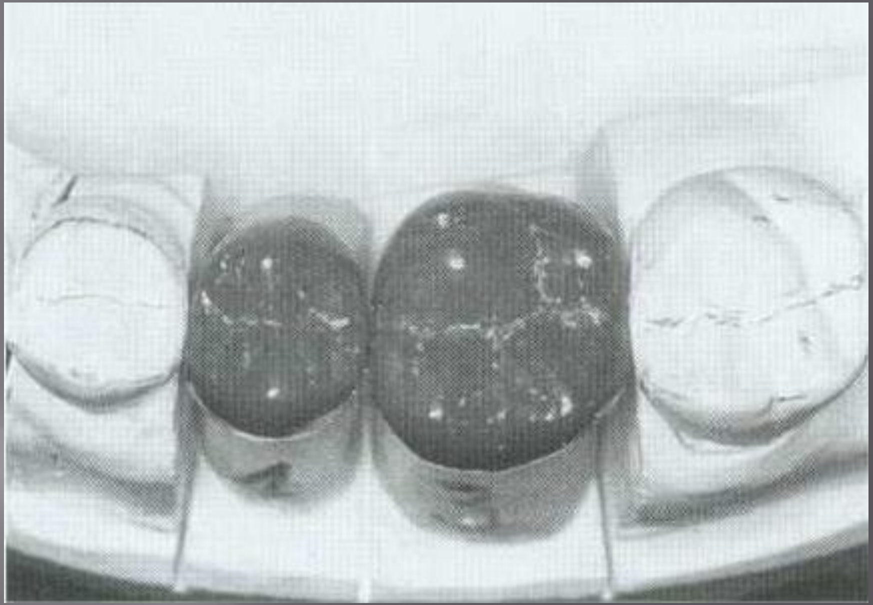


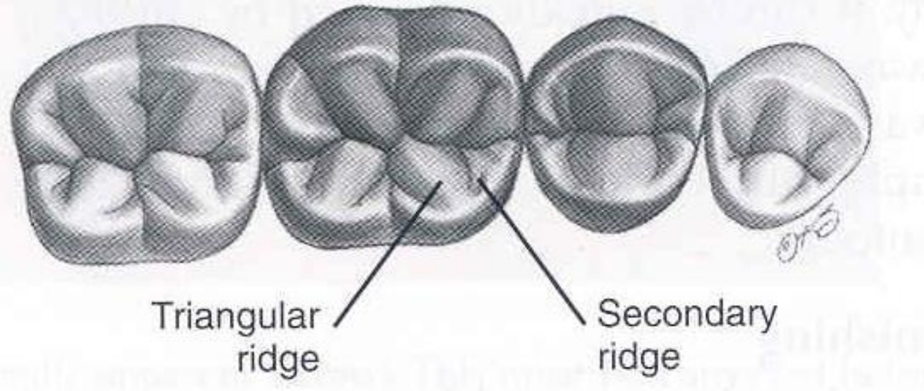




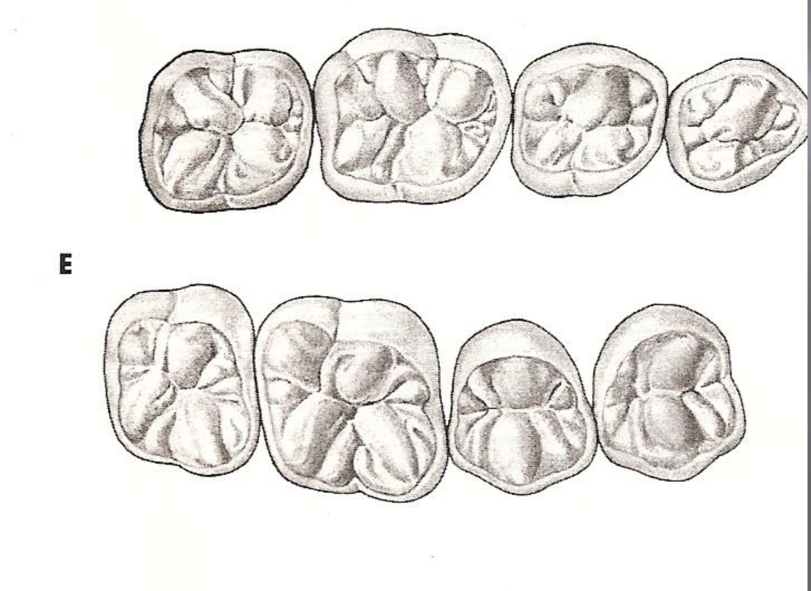
Secondary Ridges

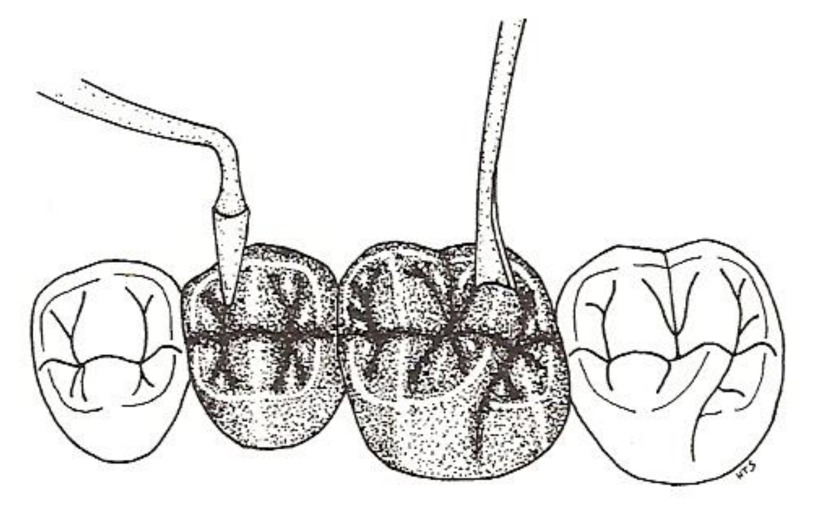
Make two secondary or supplemental ridges adjacent to each triangular ridge.





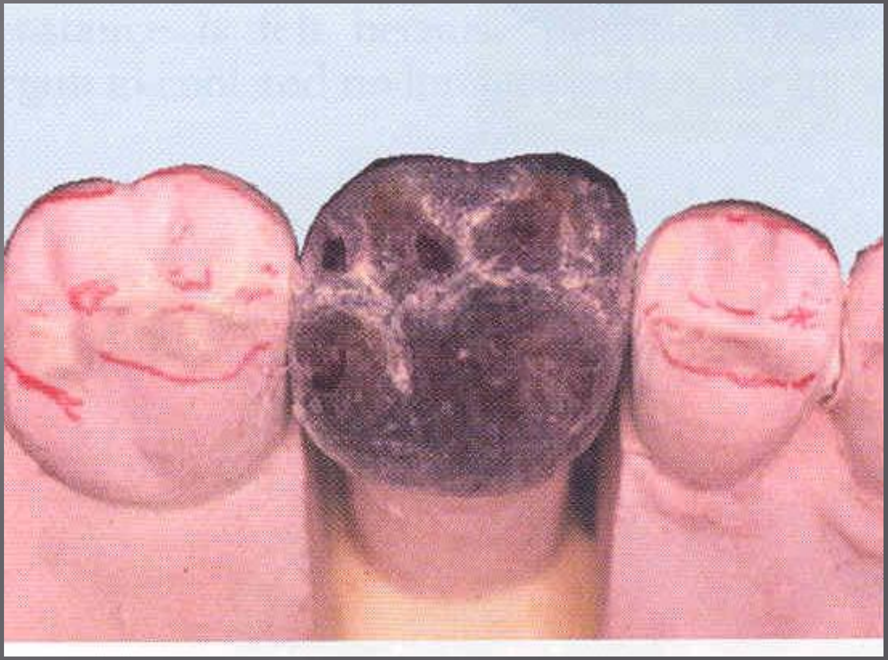
5-Occlusal morphology completed with supplemental anatomy

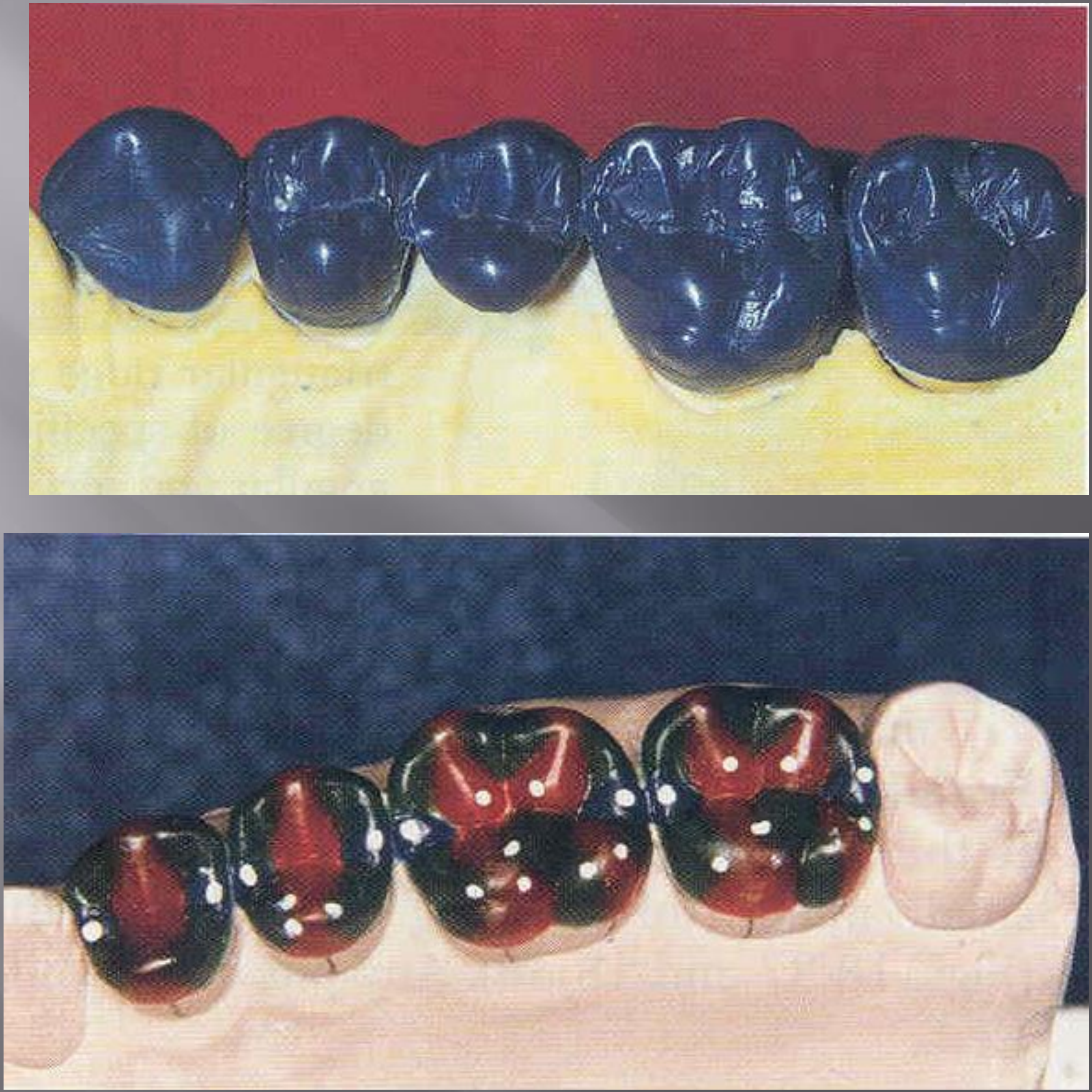


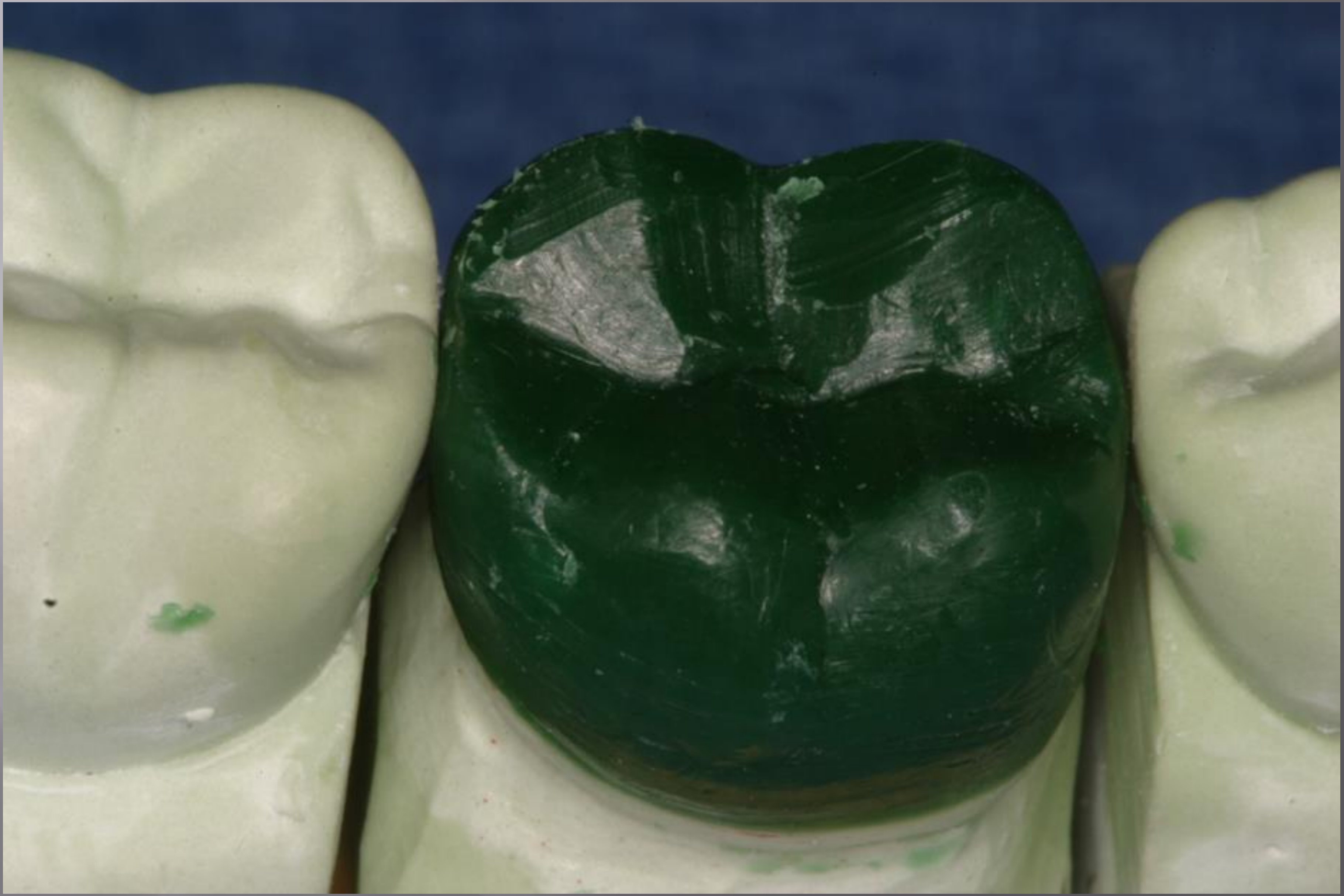


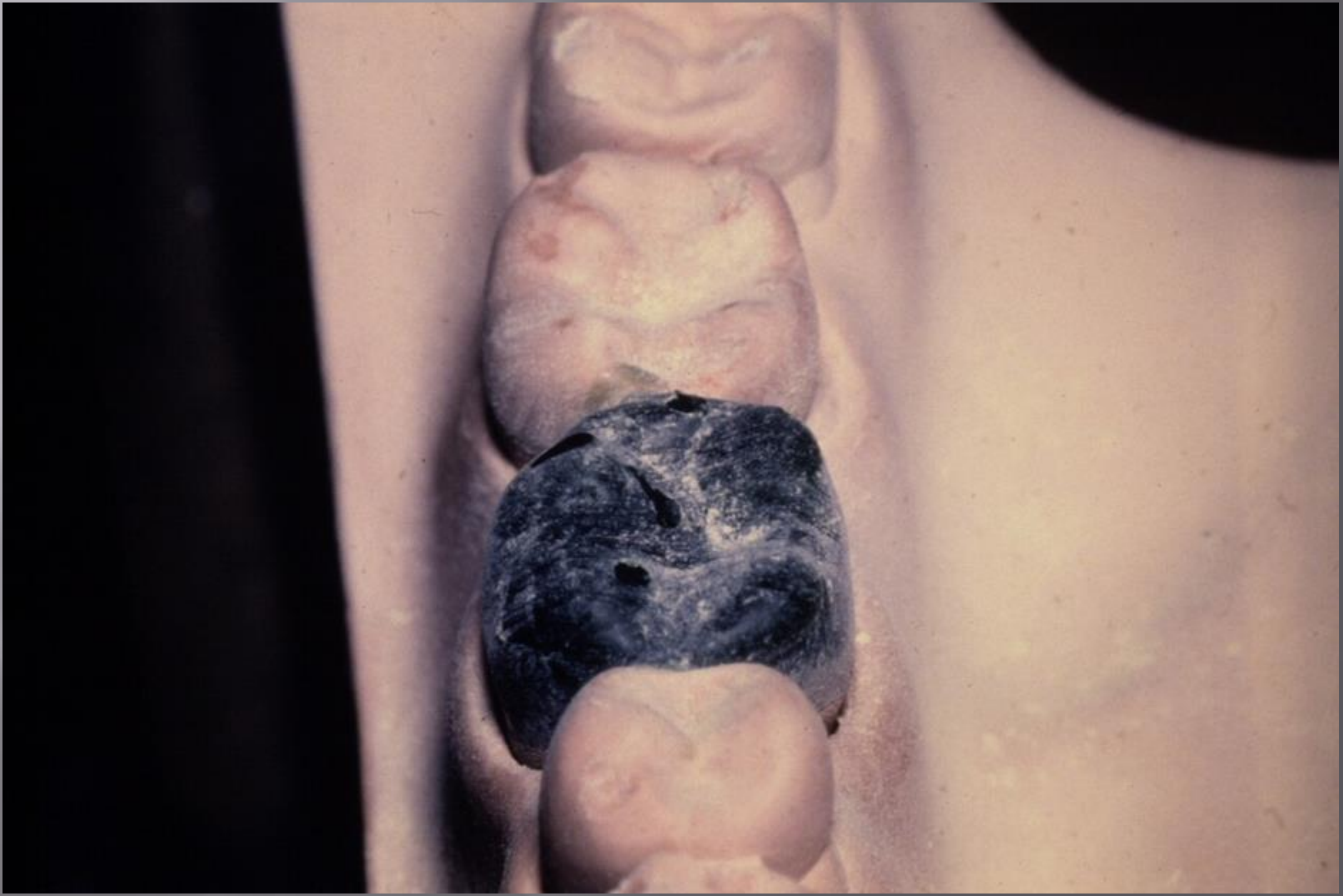
Evaluation

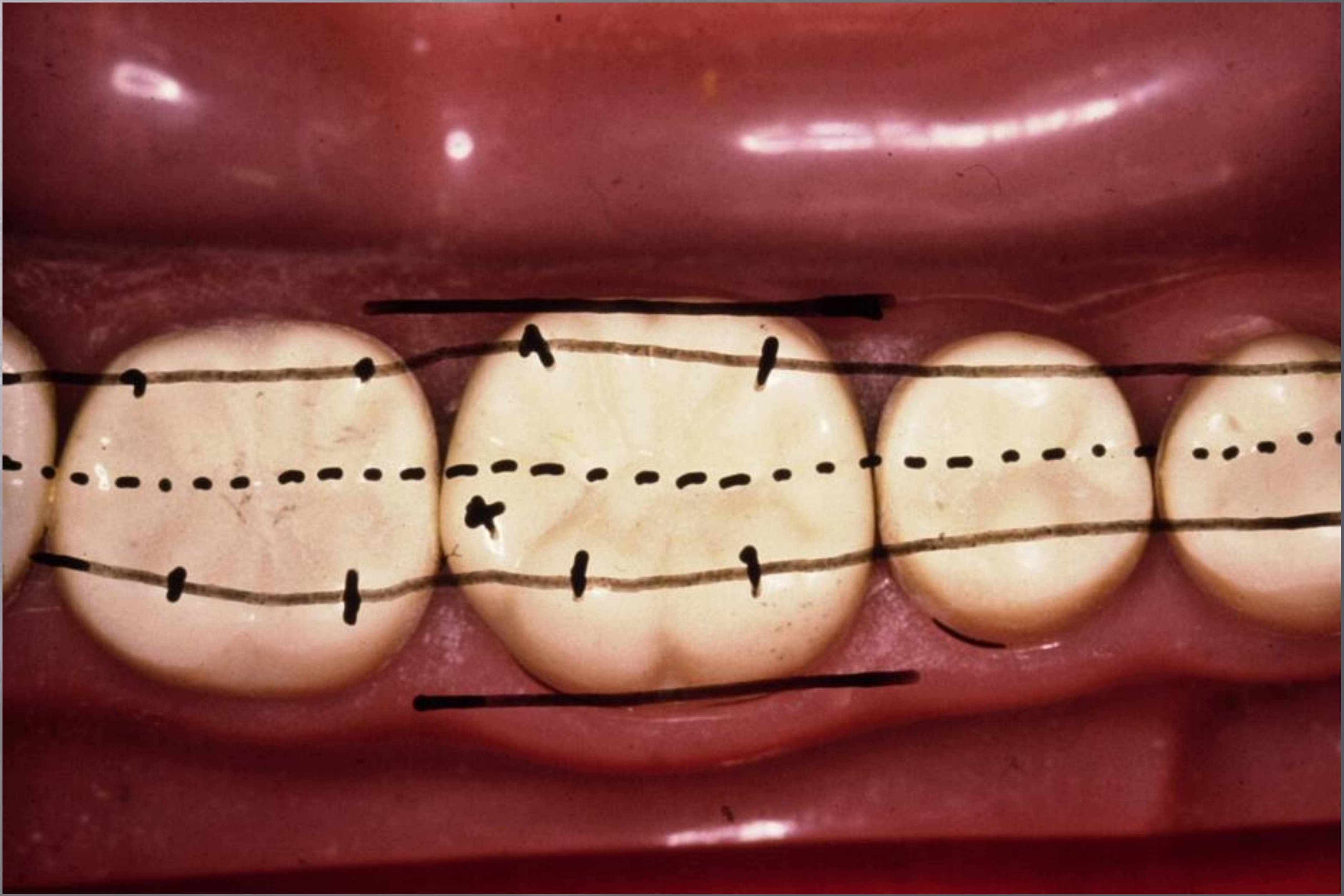
The triangular ridges are dusted with zinc stearate or powdered wax. The cusps should still have the incorrect sharp contour and should not be rounded by improper polishing.

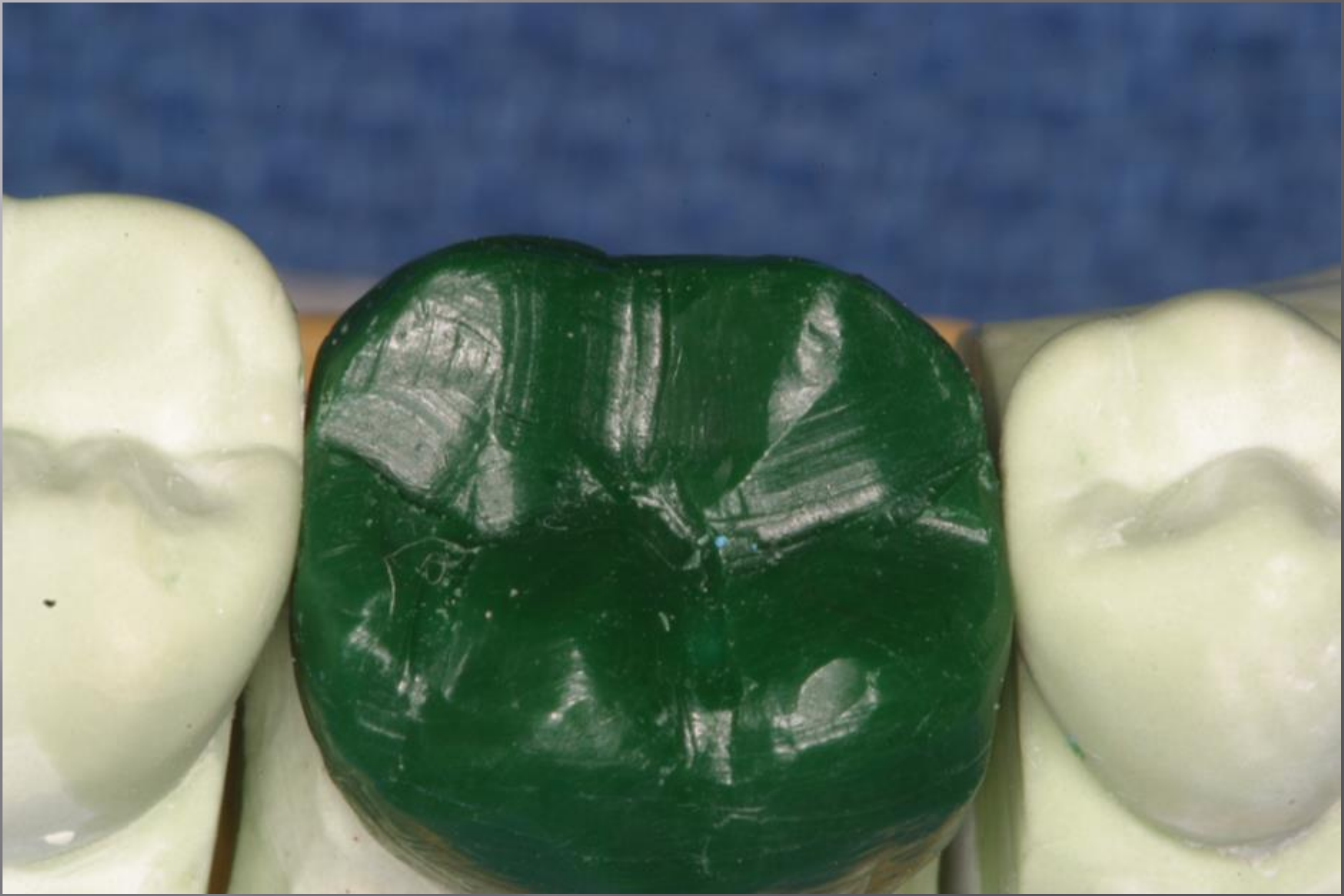


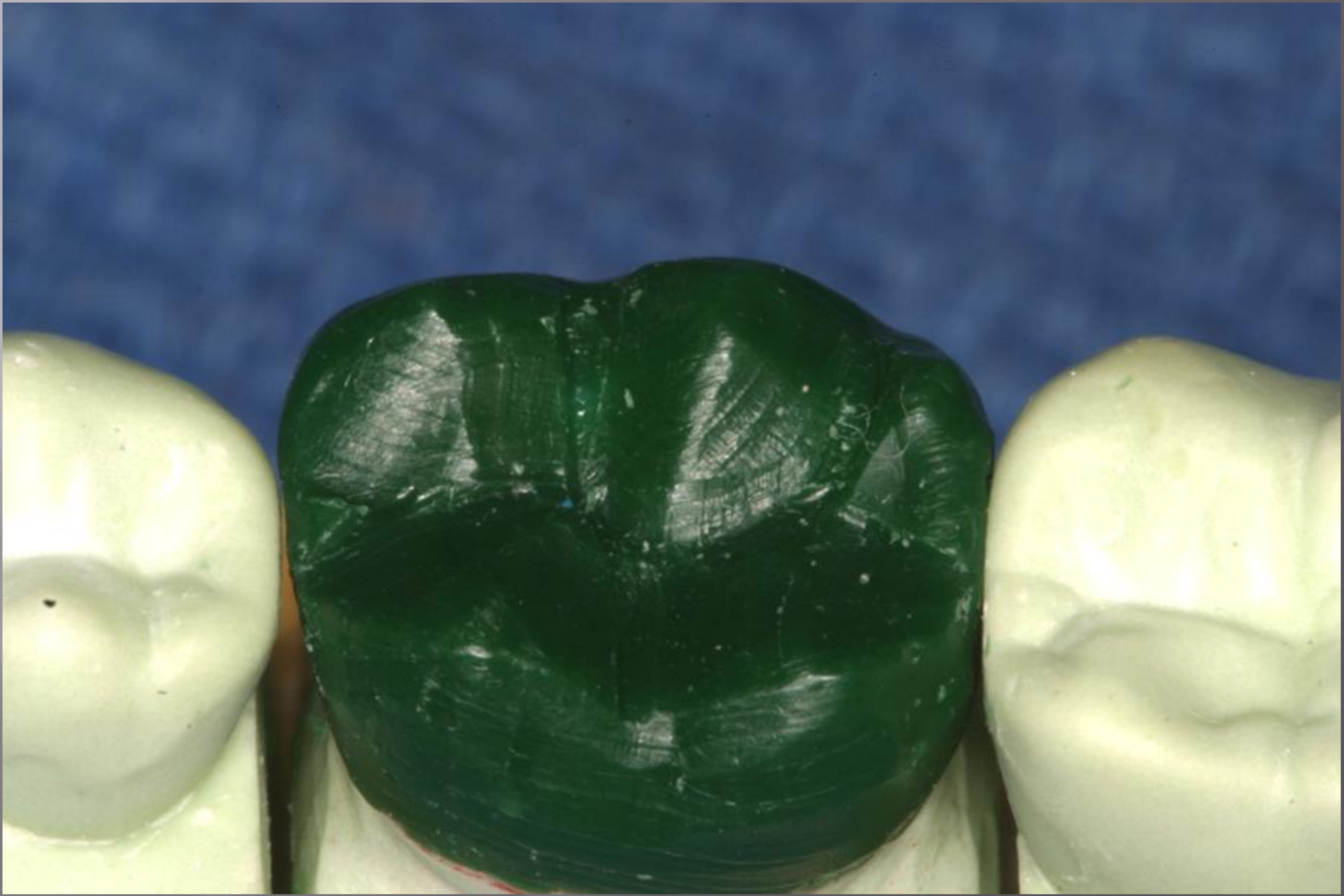


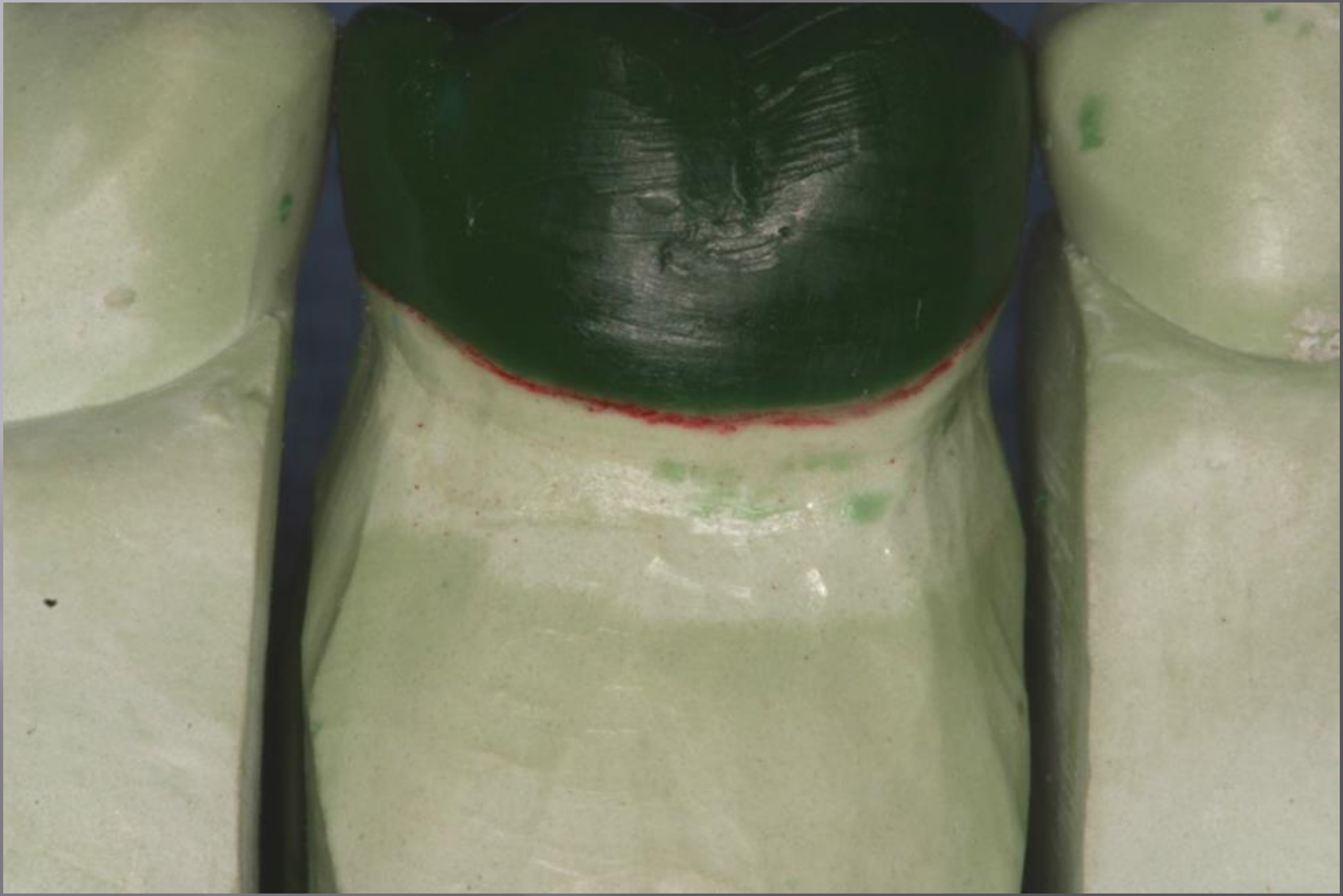


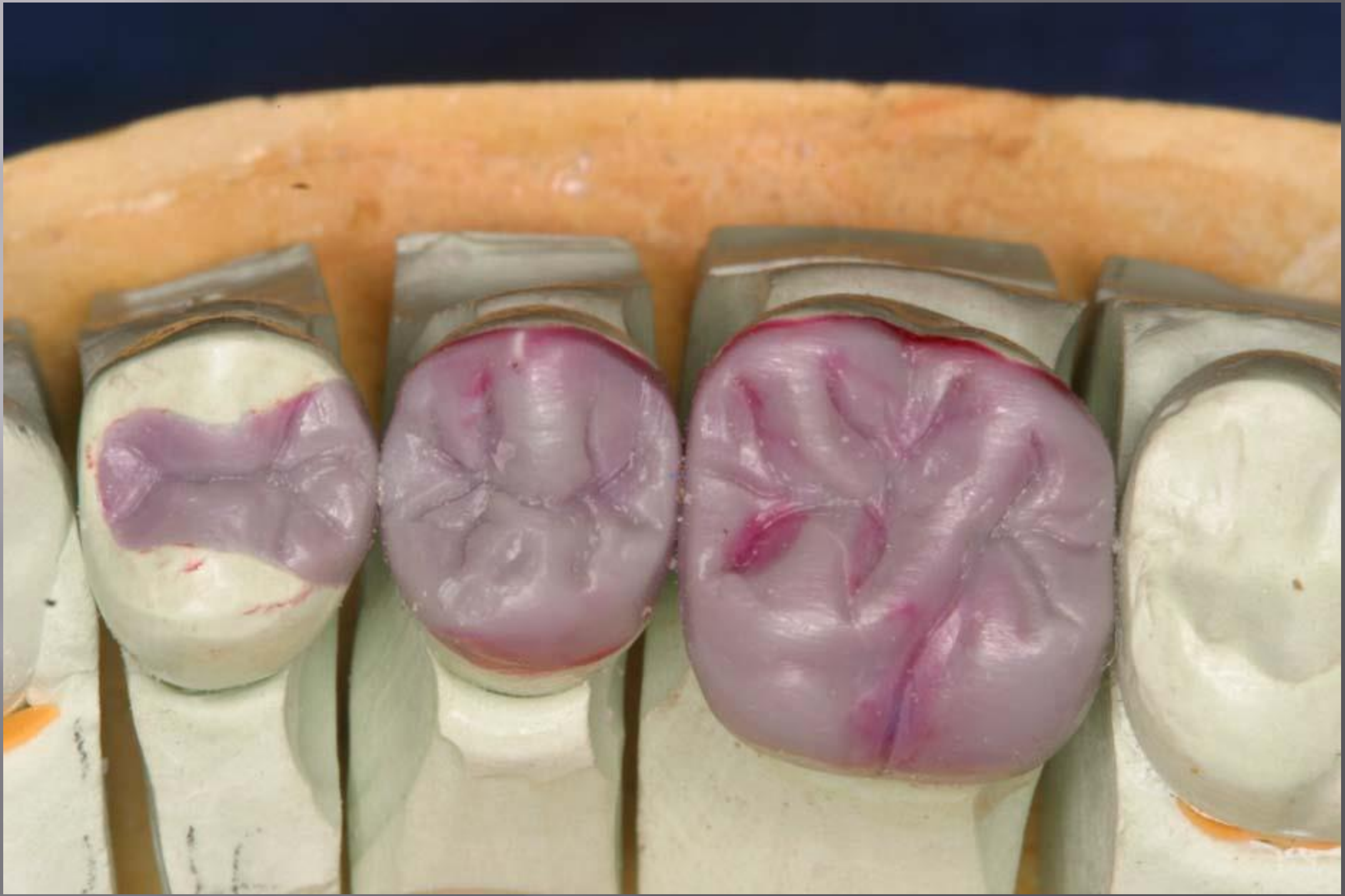


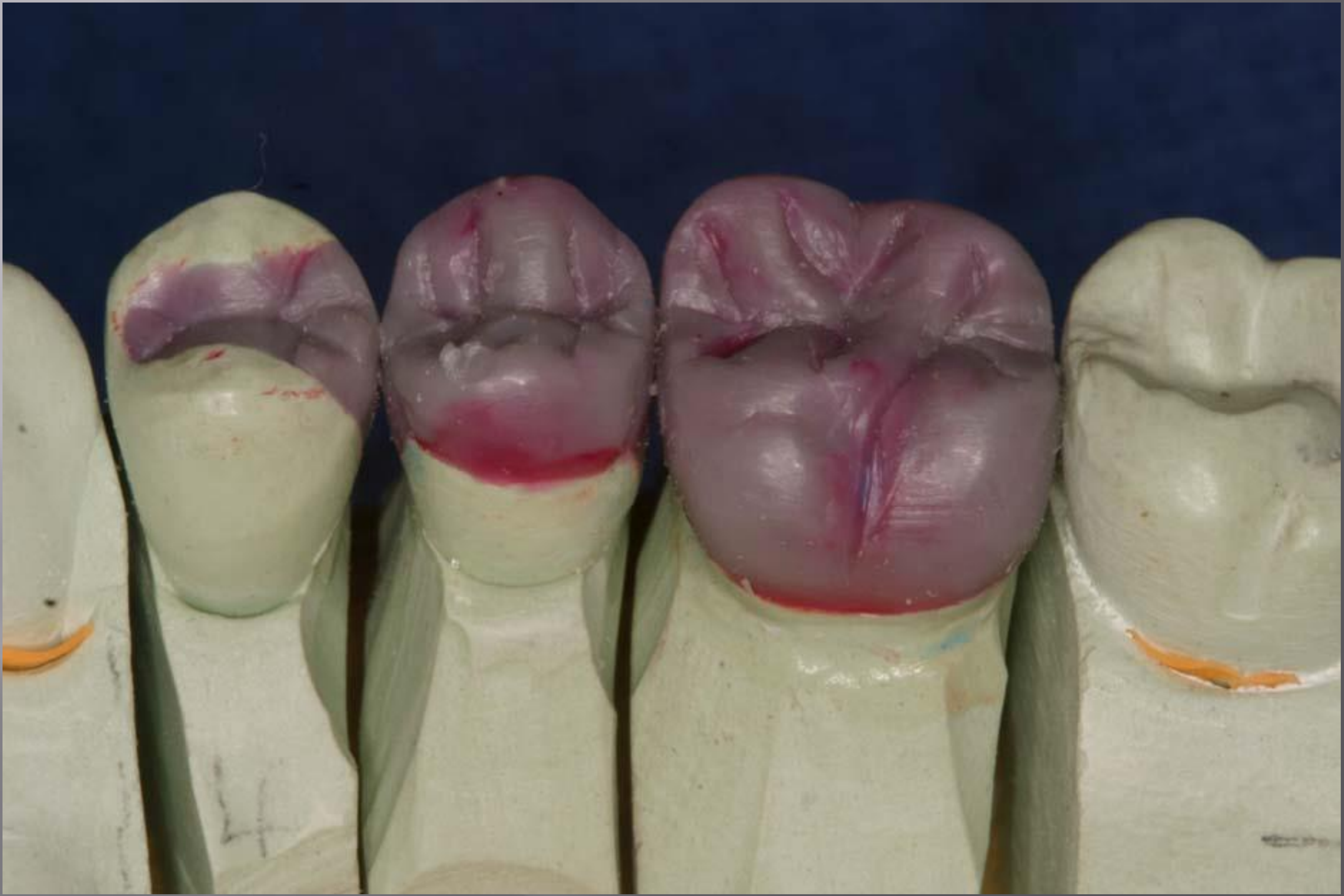


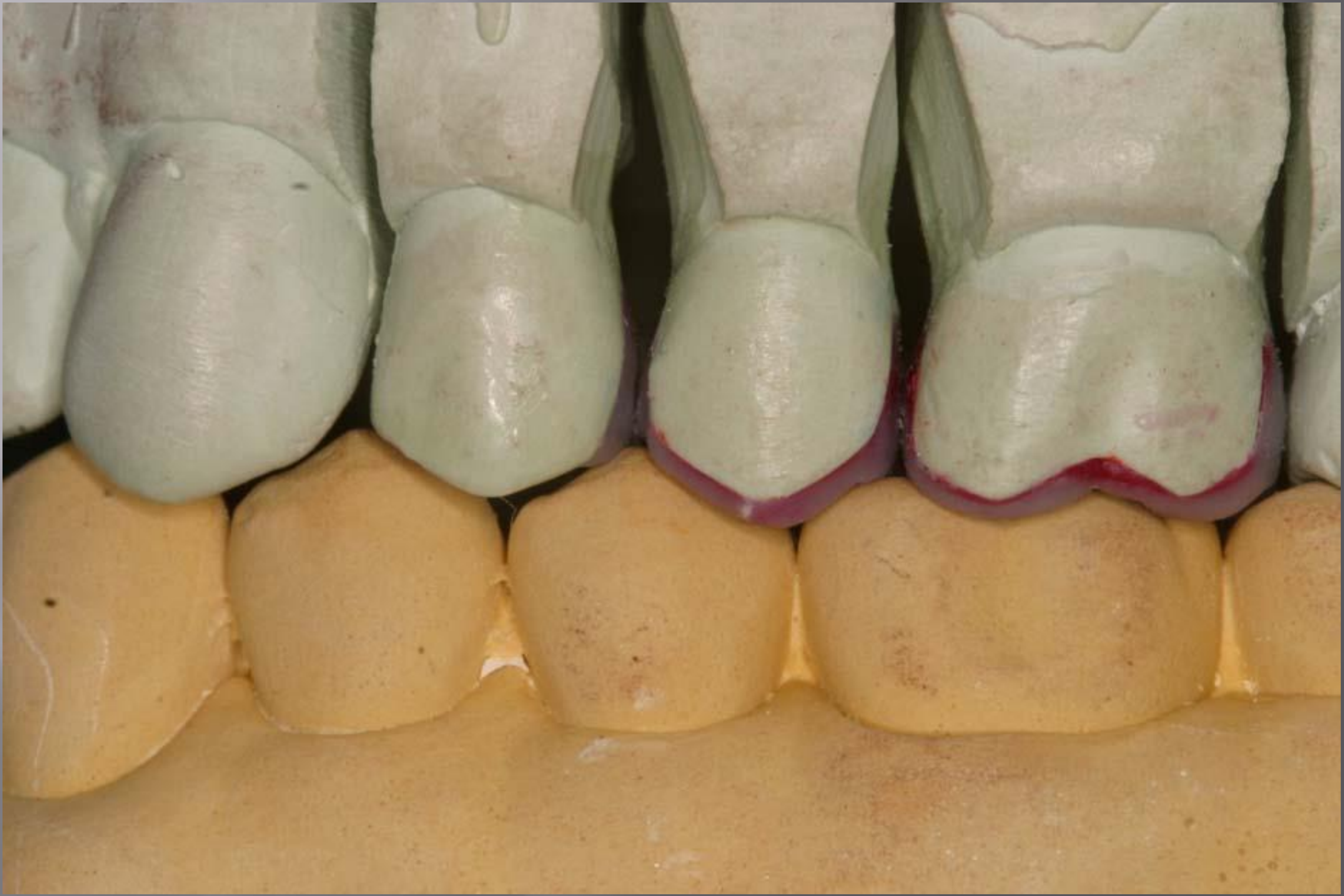


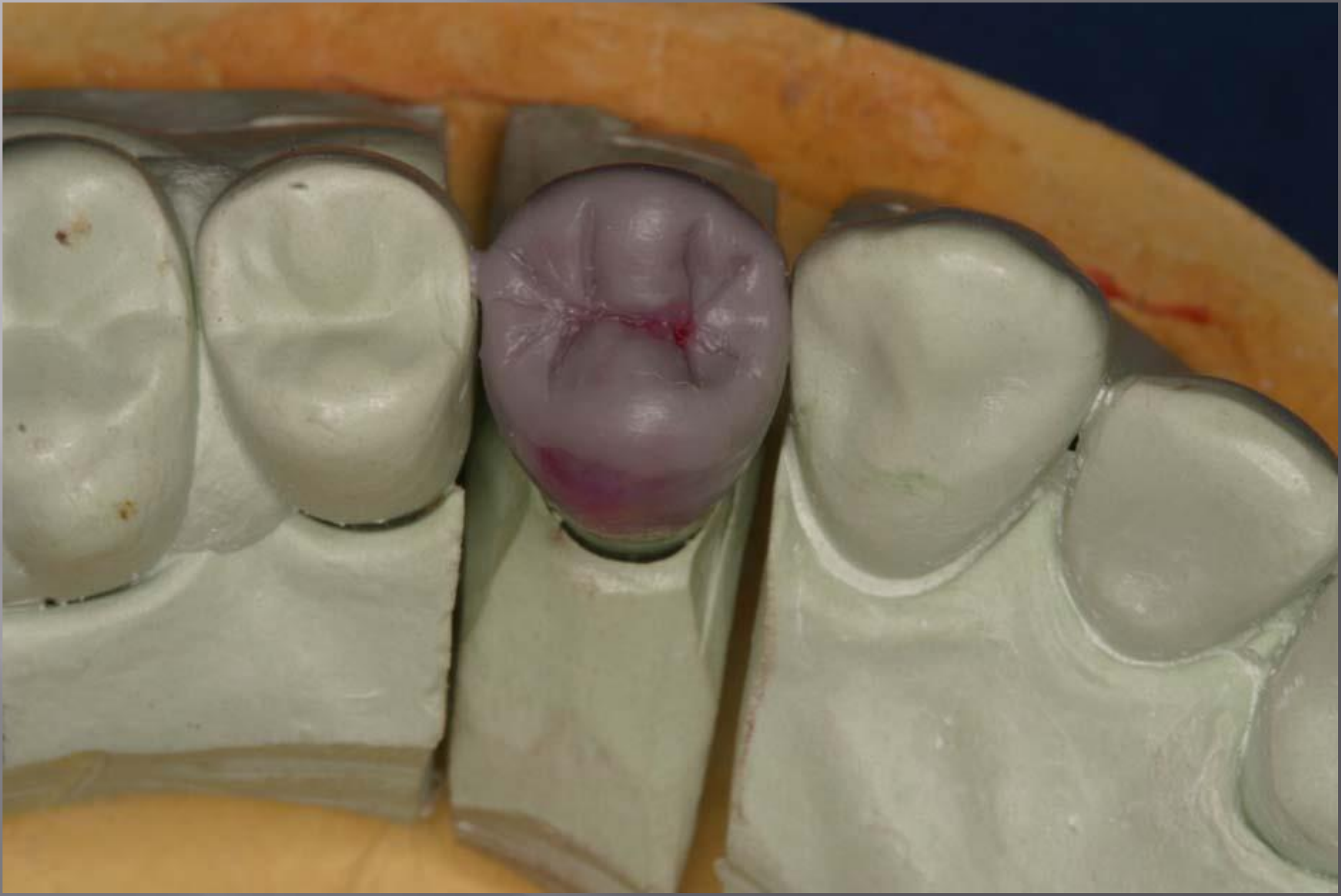












Finish Pattern

- Finalize Axial Contours

- Finish Margins
  - Remove flash
  - Wax to finish lines
  - Check for voids and cracks

- Final Polish/Smooth
  - Cotton roll
  - Do not use flame

- Invest Pattern for Casting

Margin Finishing

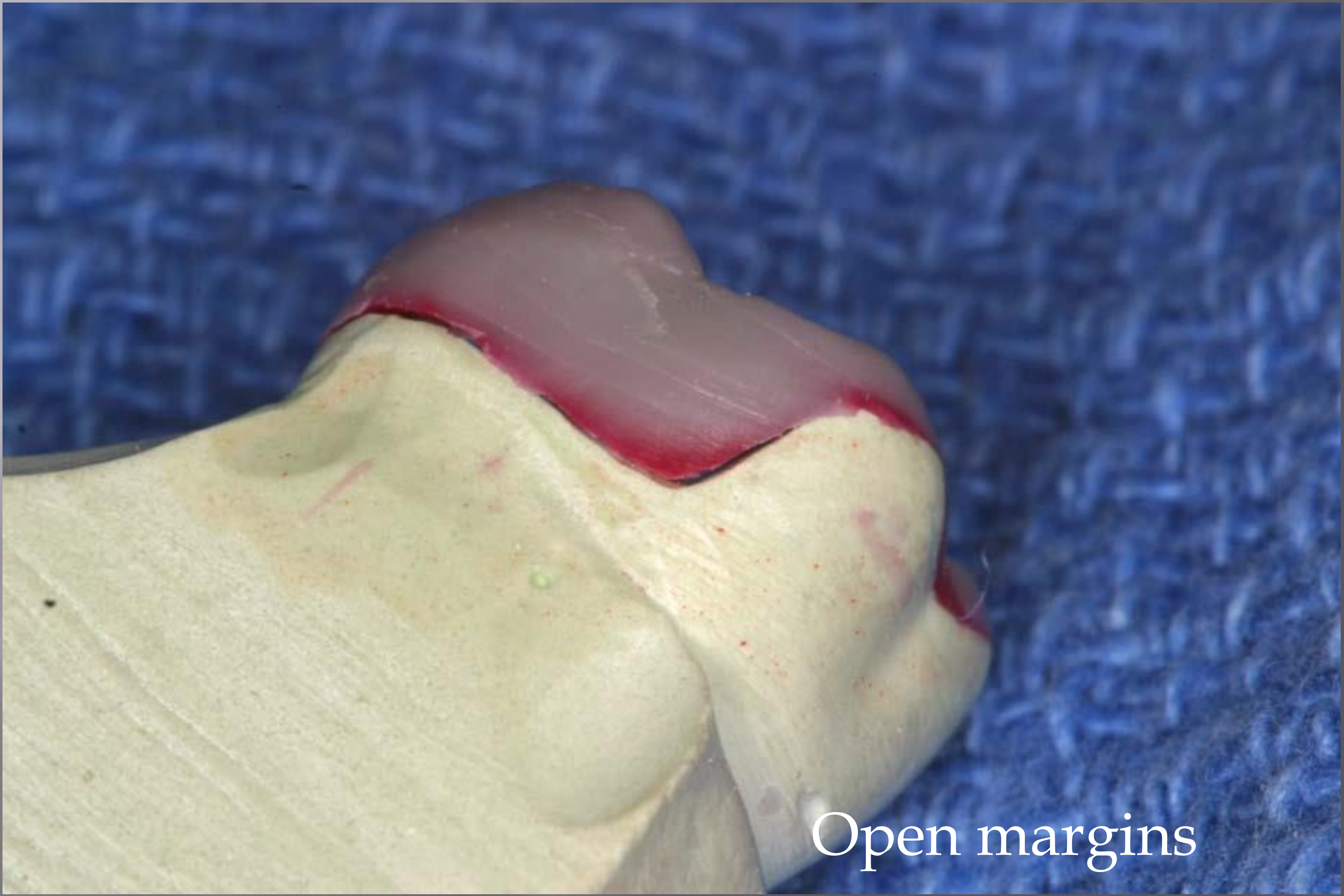
To optimize the adaptation of the wax pattern (and the cast restoration) to the die, the margins must be reflowed and refinished immediately before investing the wax pattern.

objectives are

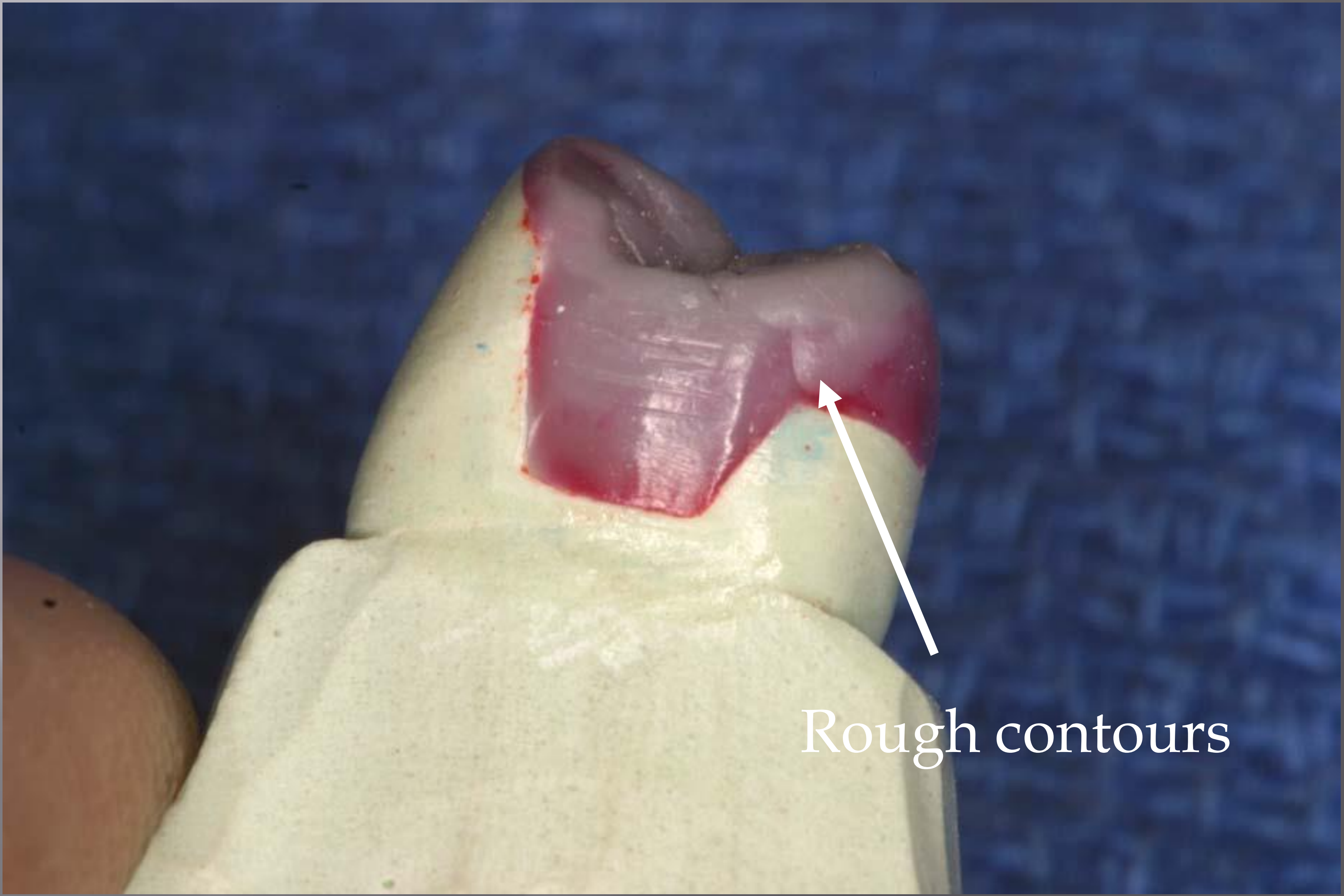
(1) Minimizing dissolution of the luting agent.

(2) Facilitating plaque control.

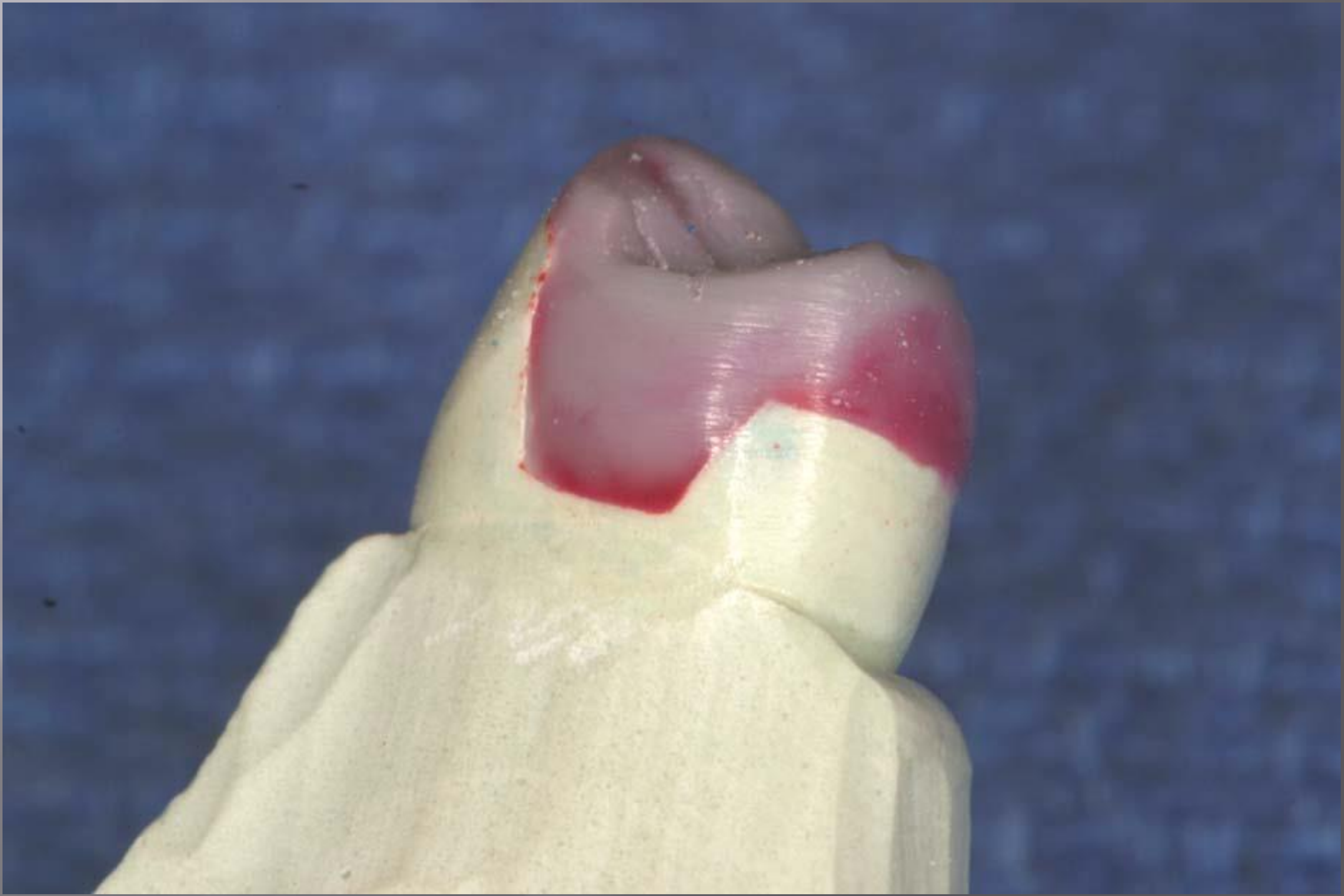
Use microscope for margin evaluation and finishing

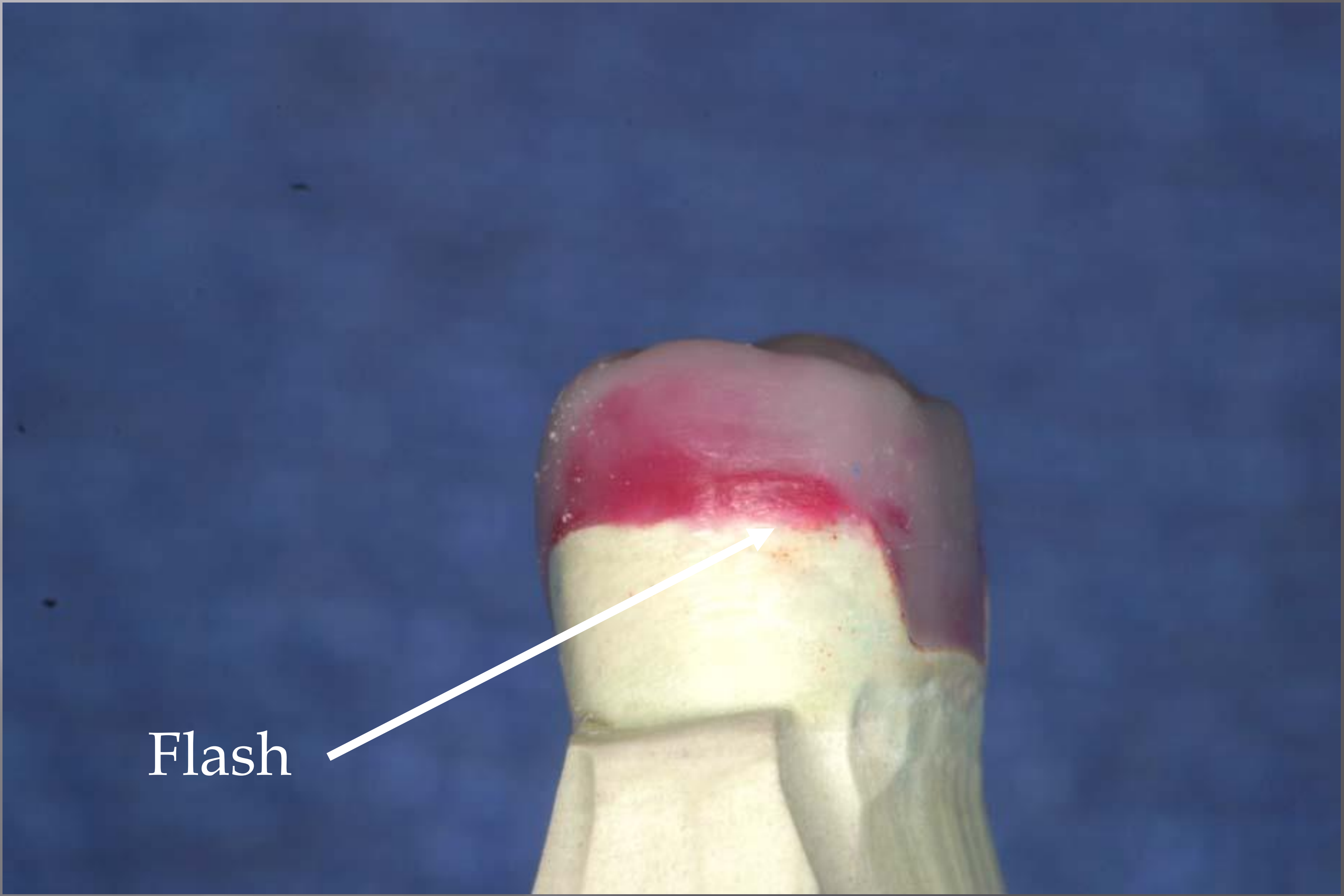


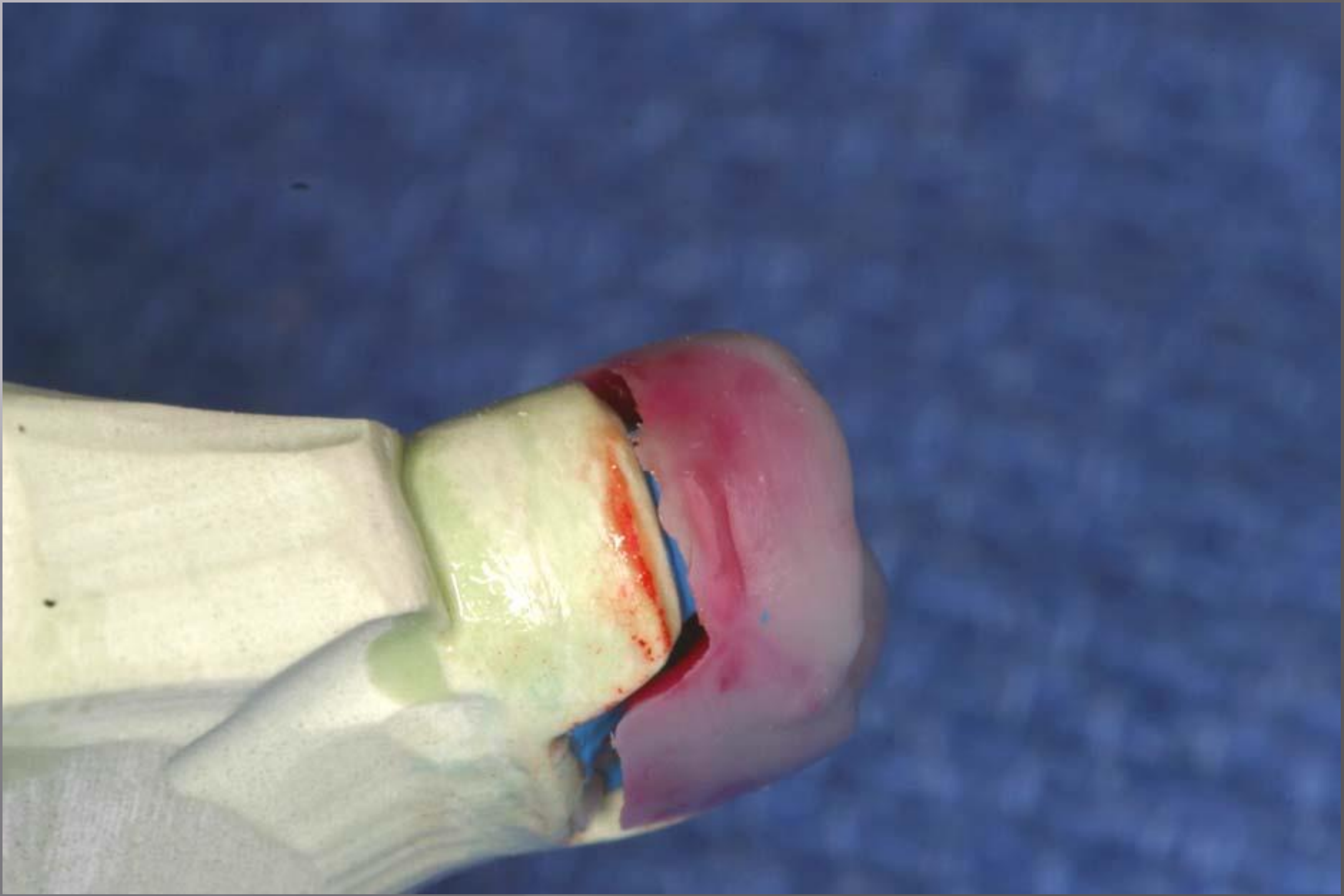
Open margins

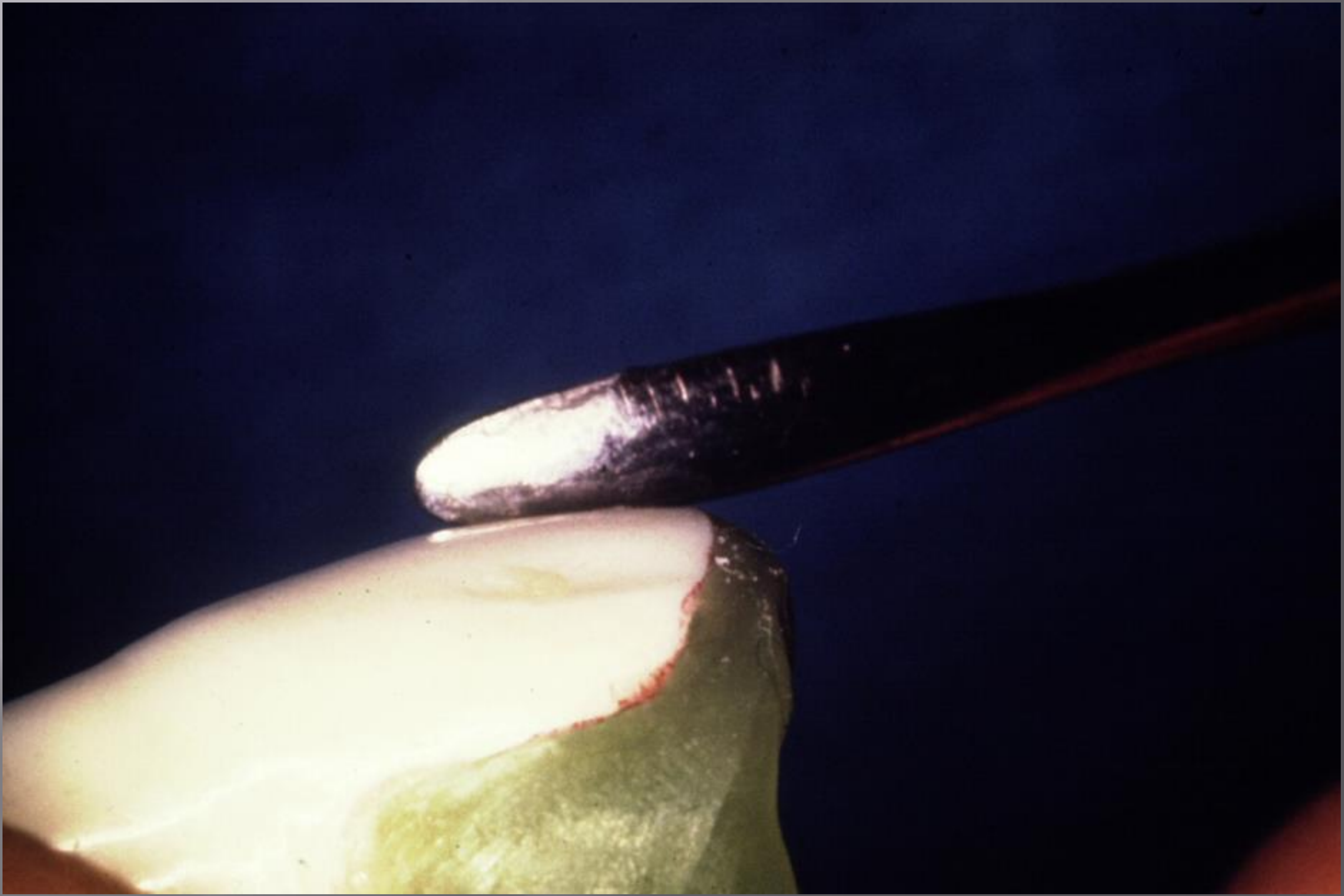


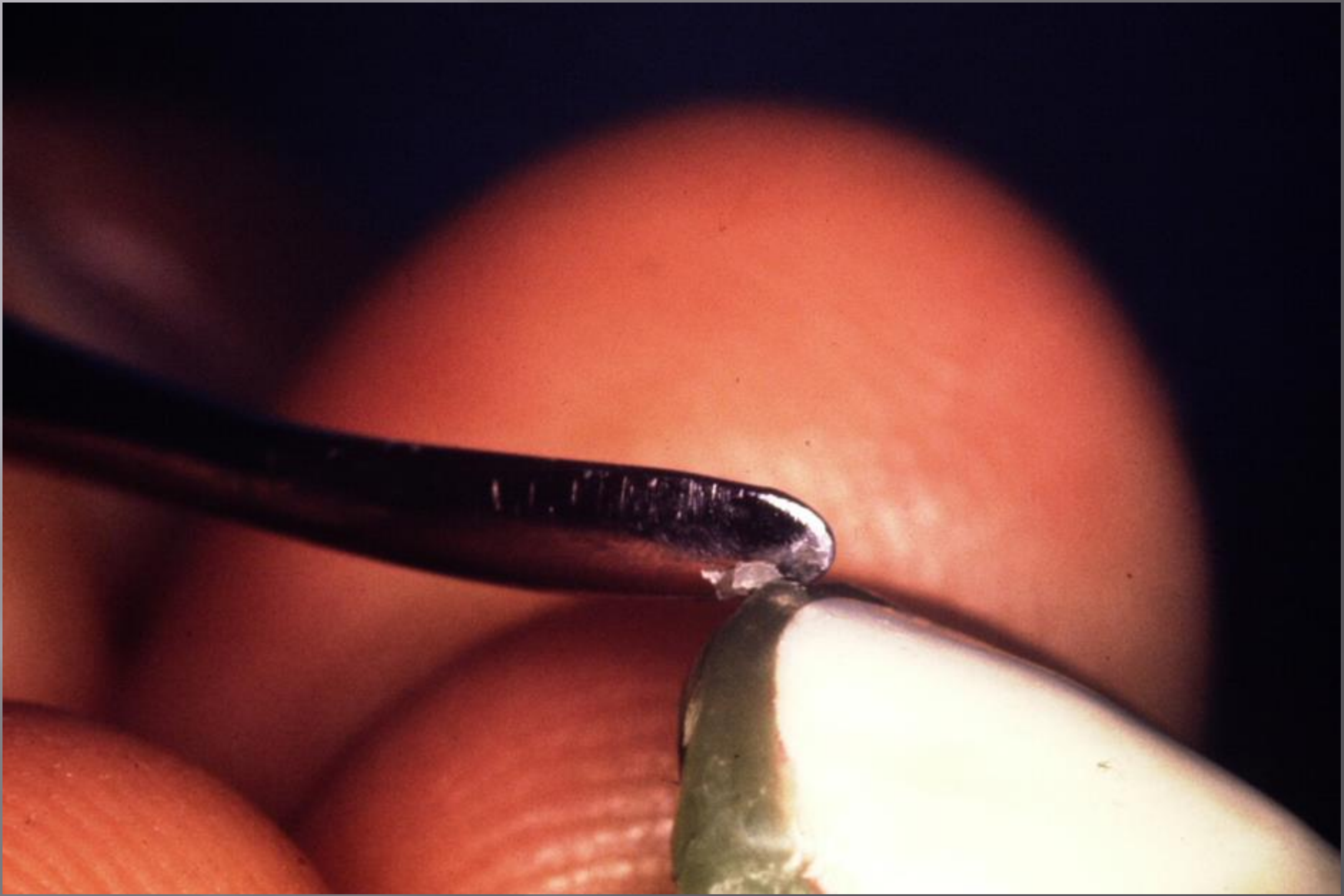
Rough contours

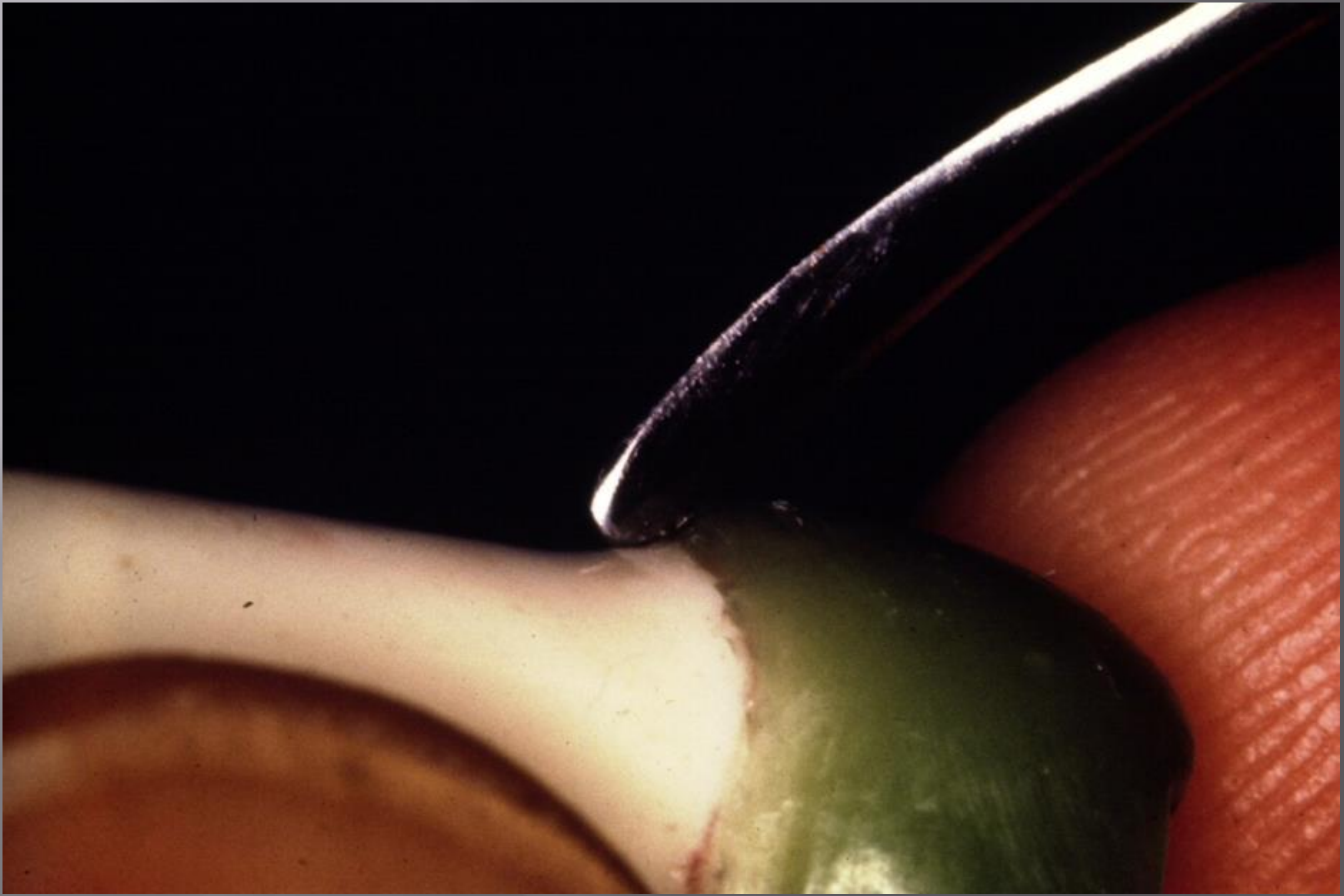


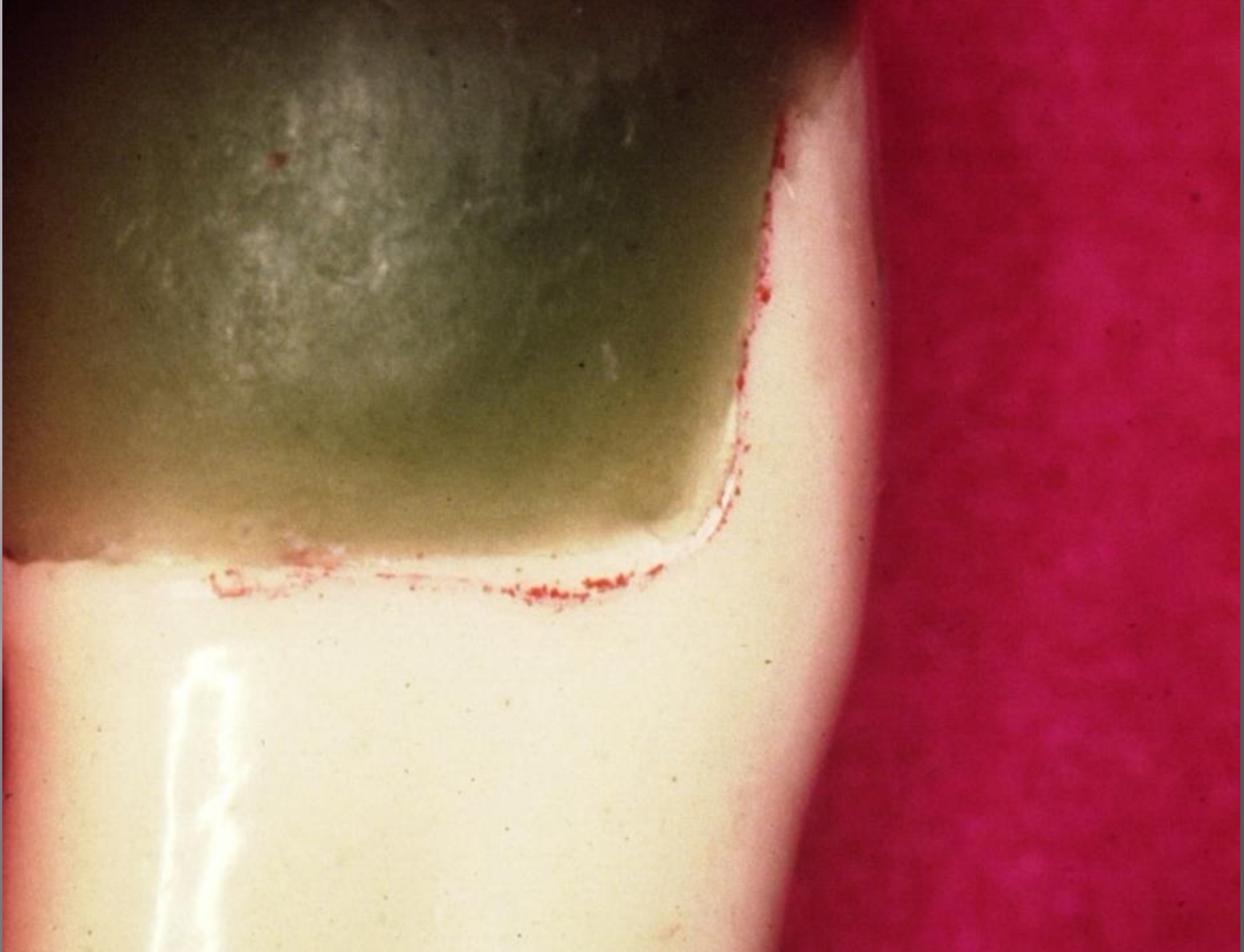

Flash

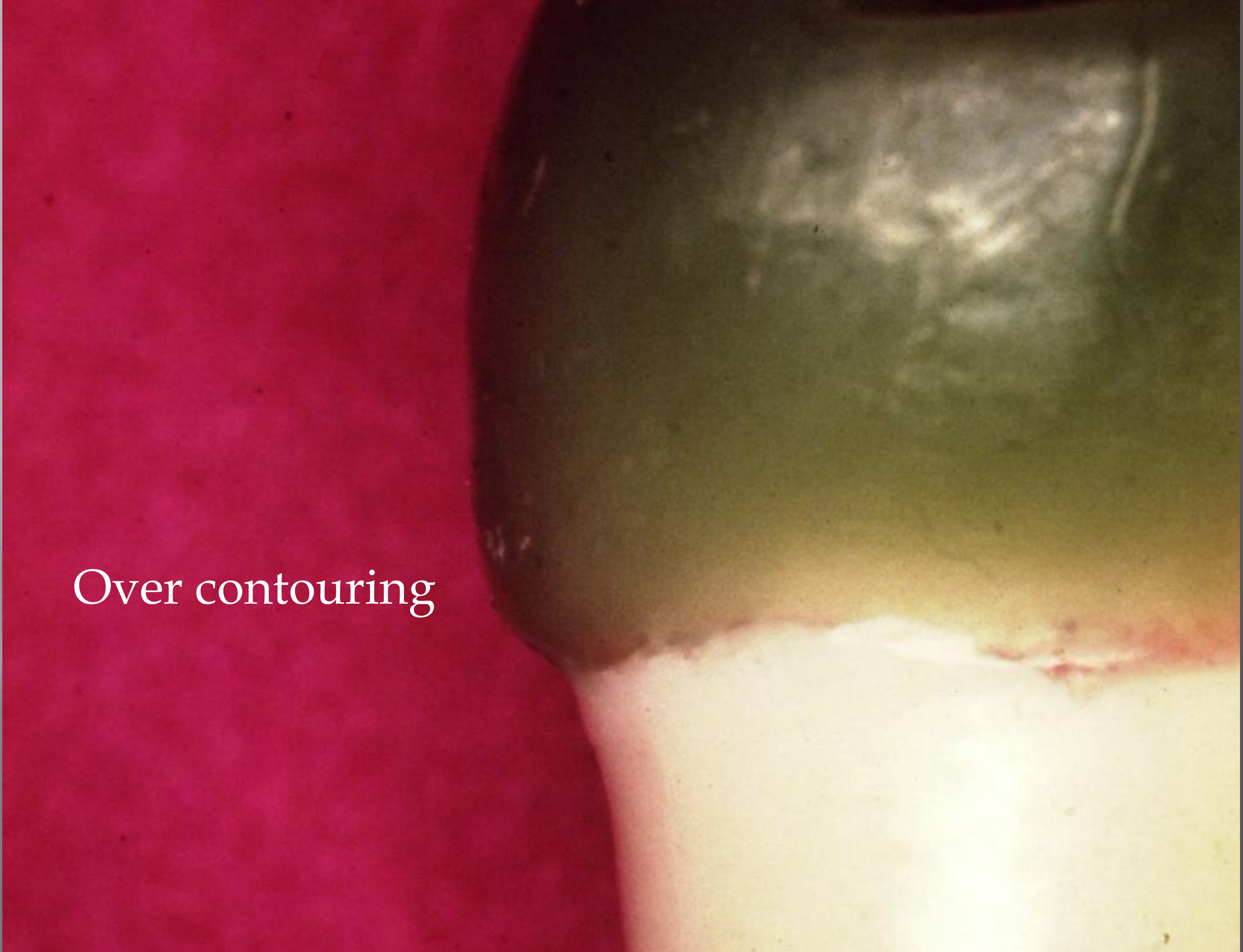




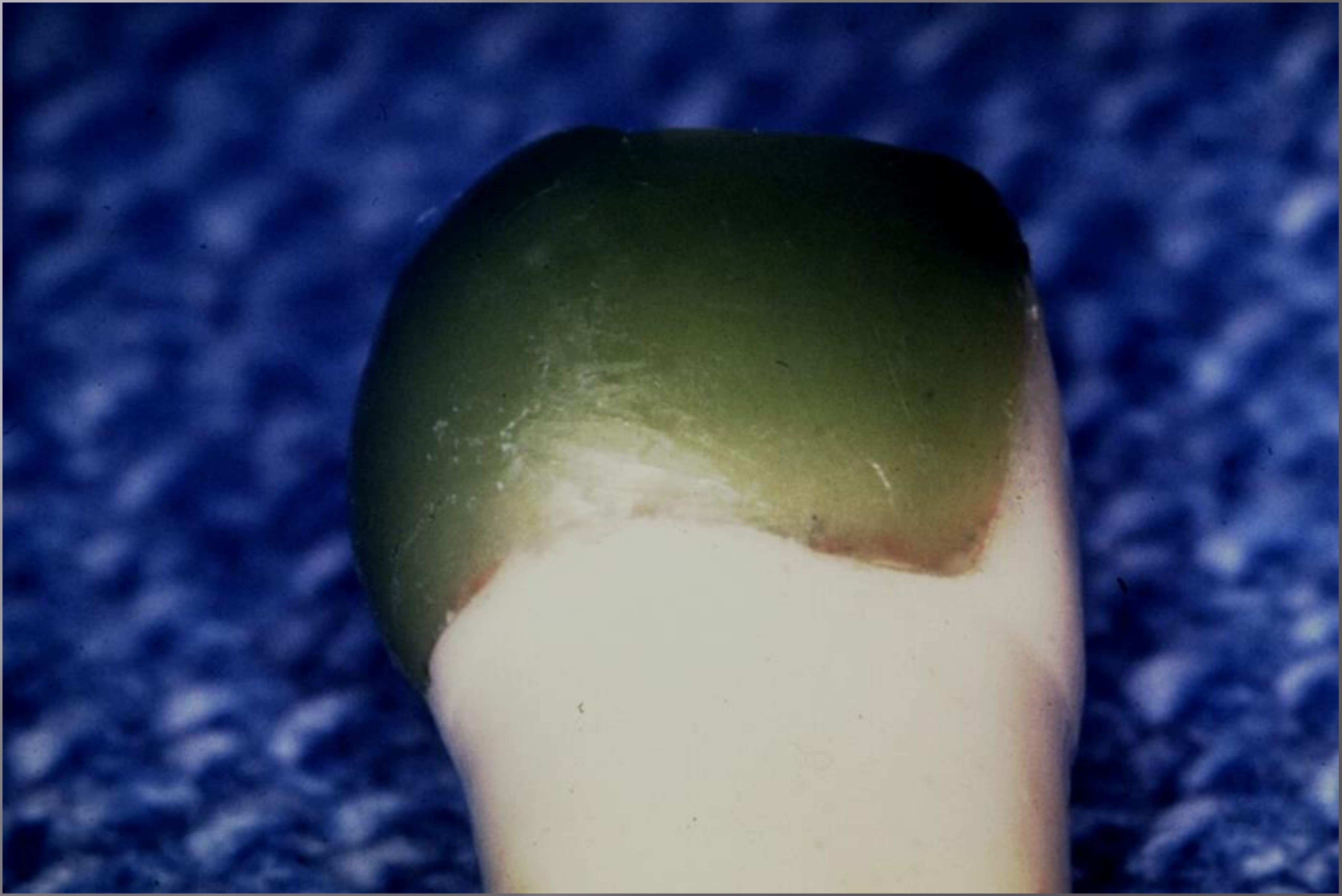


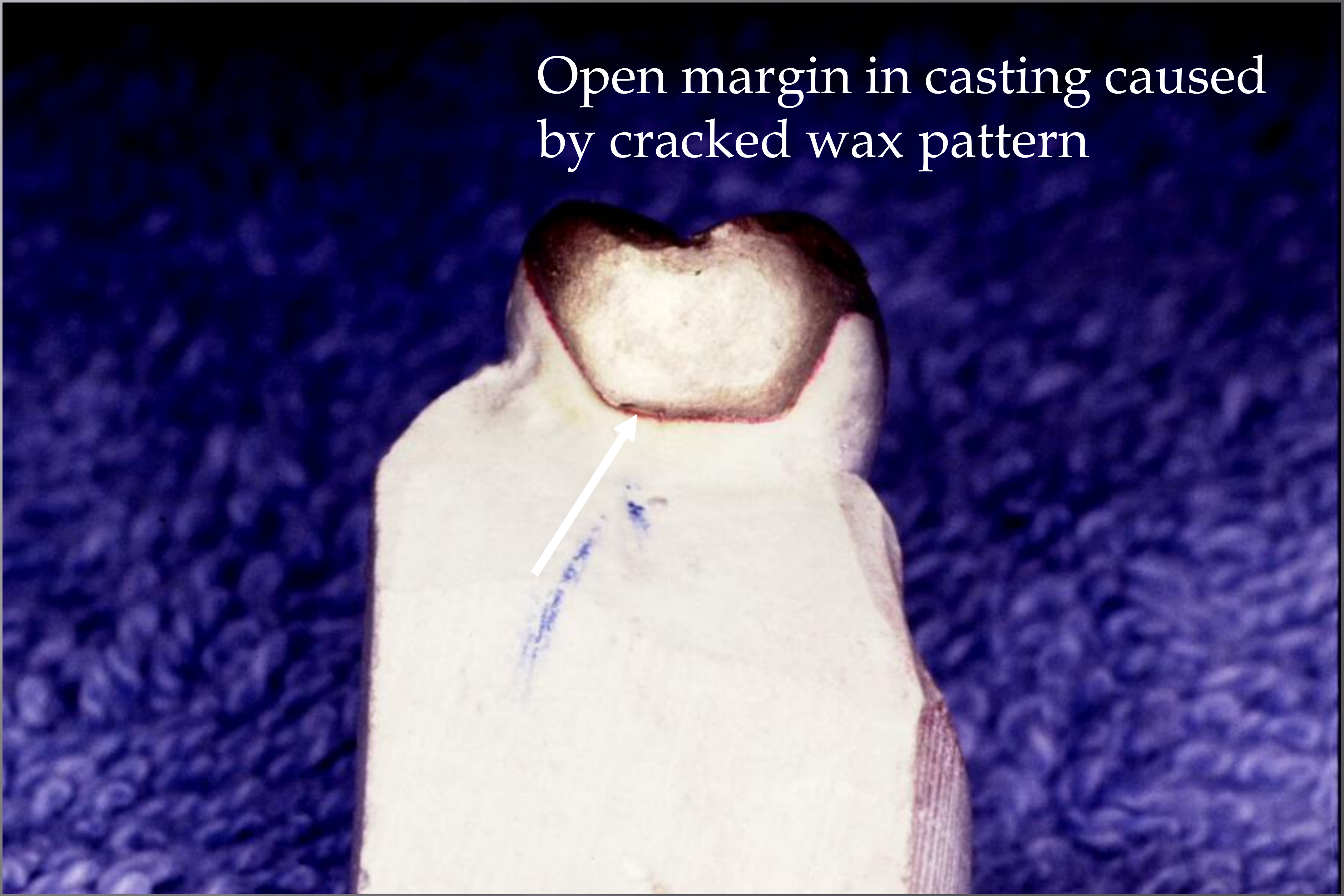




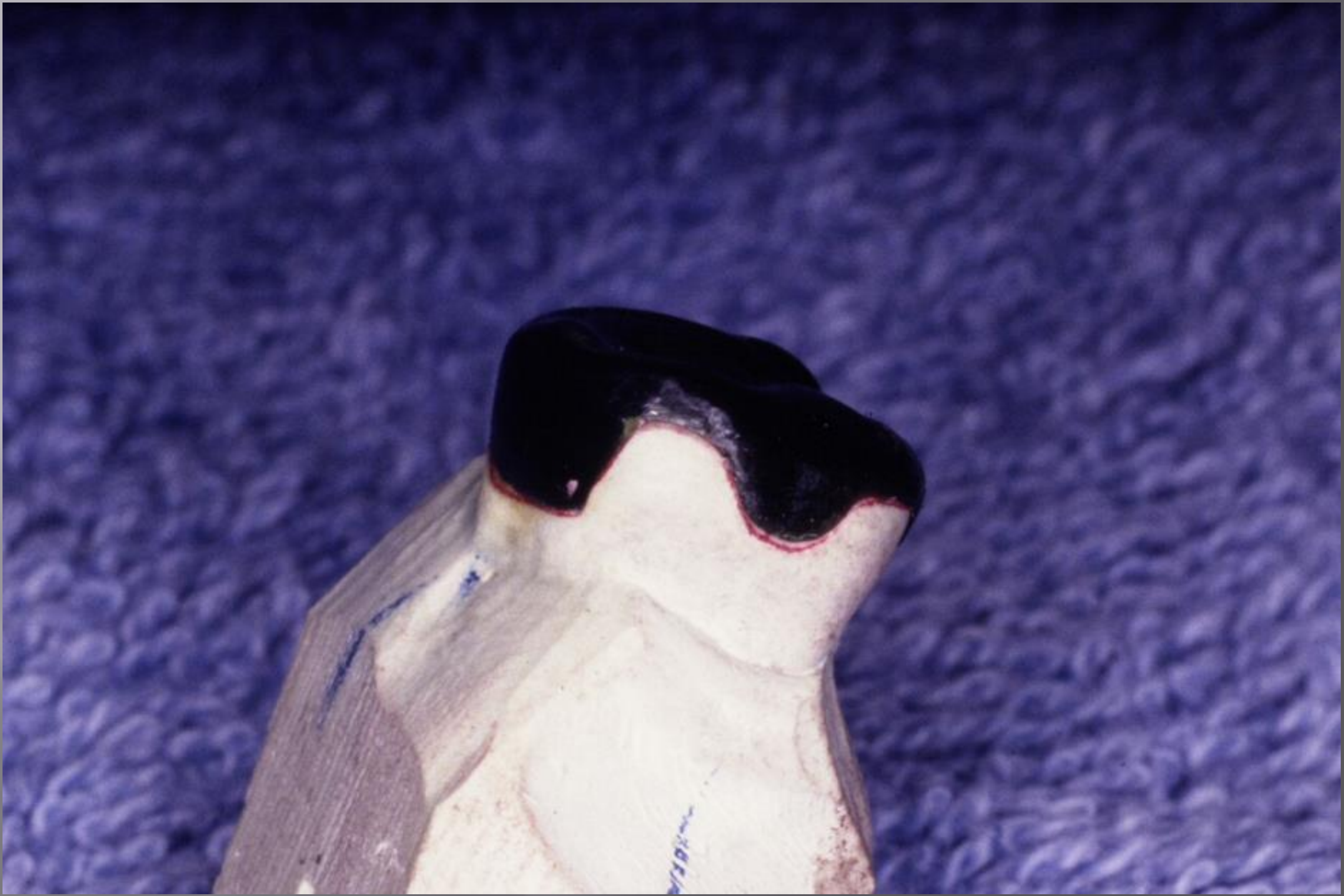


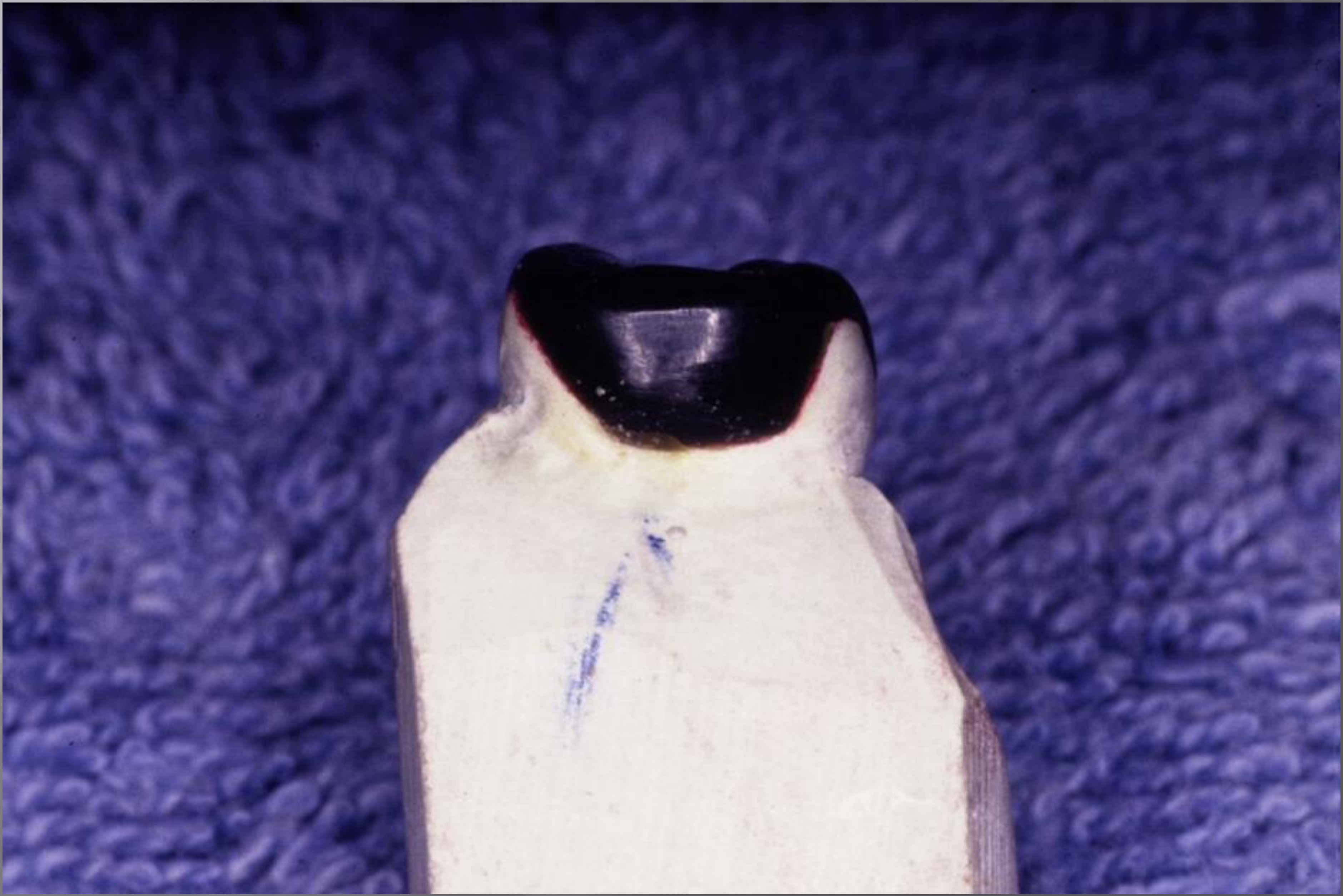
Over contouring

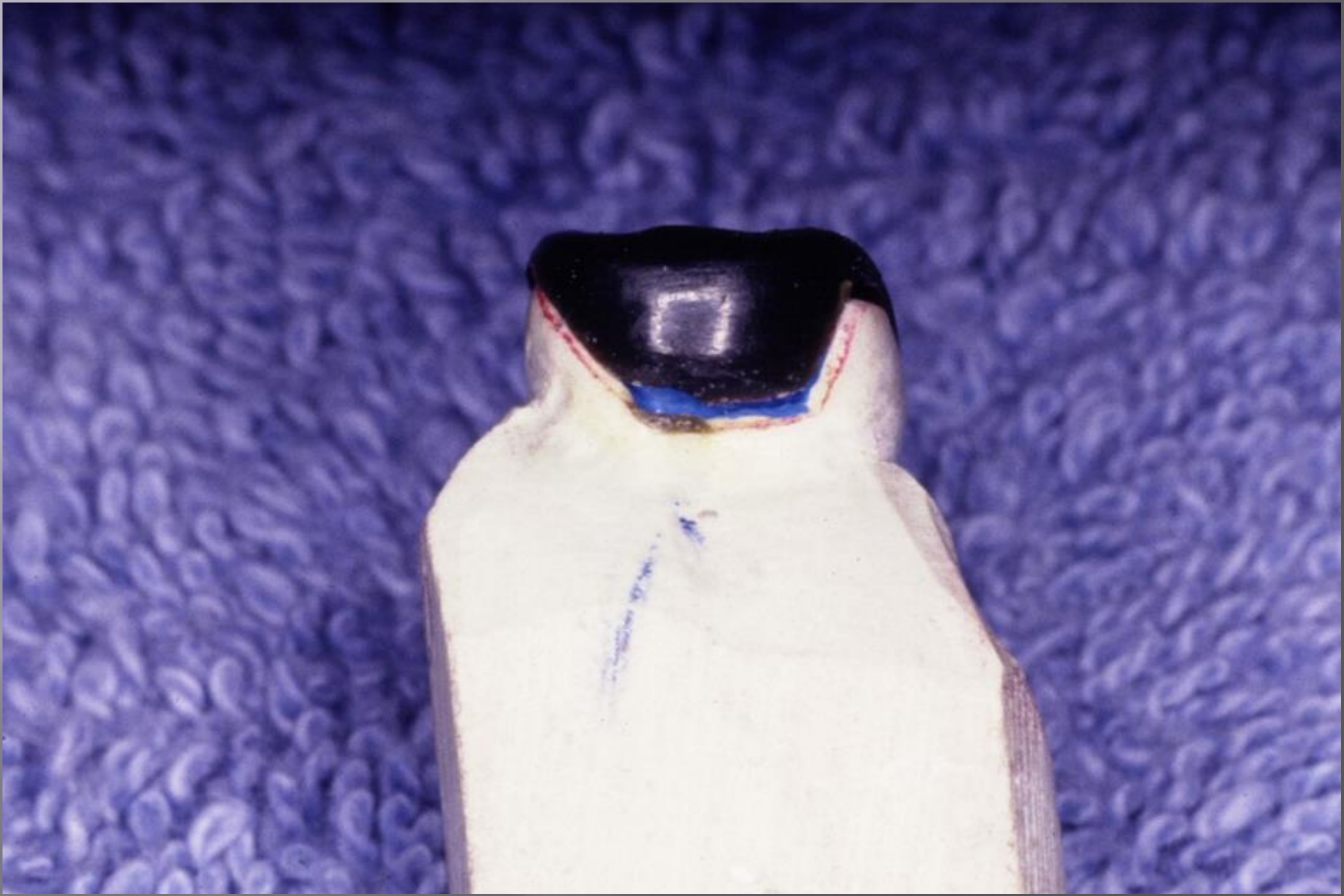


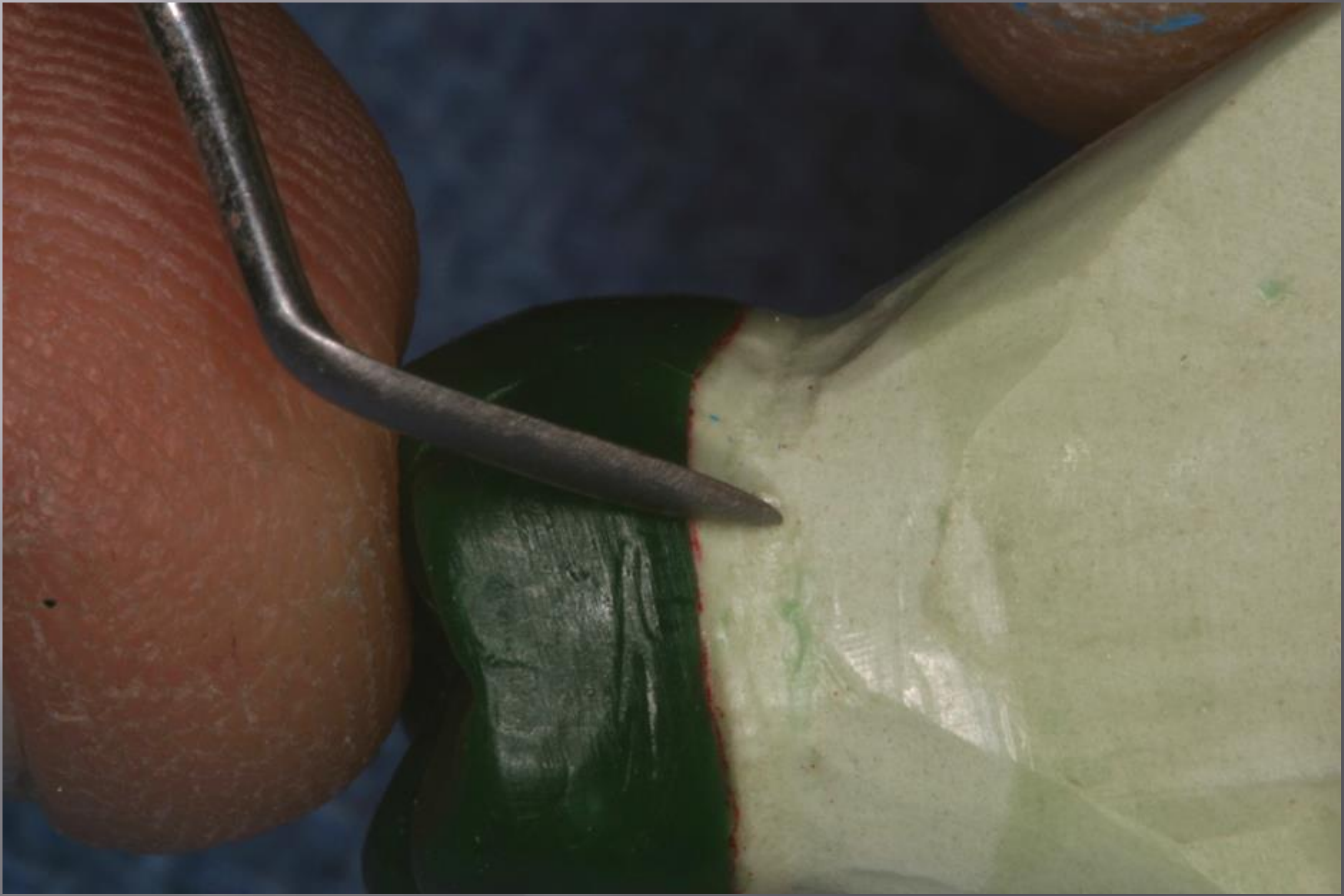


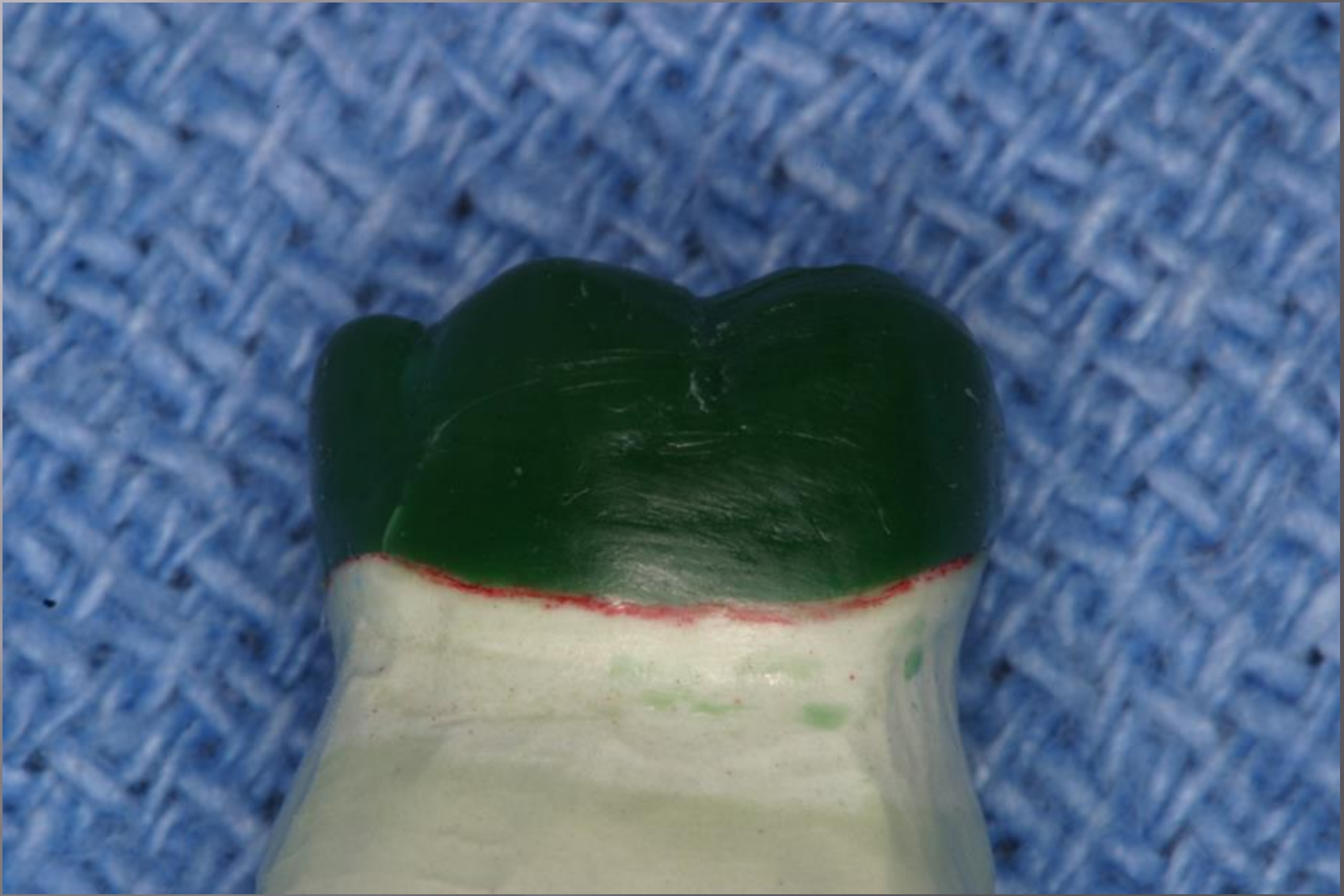
Open margin in casting caused by cracked wax pattern

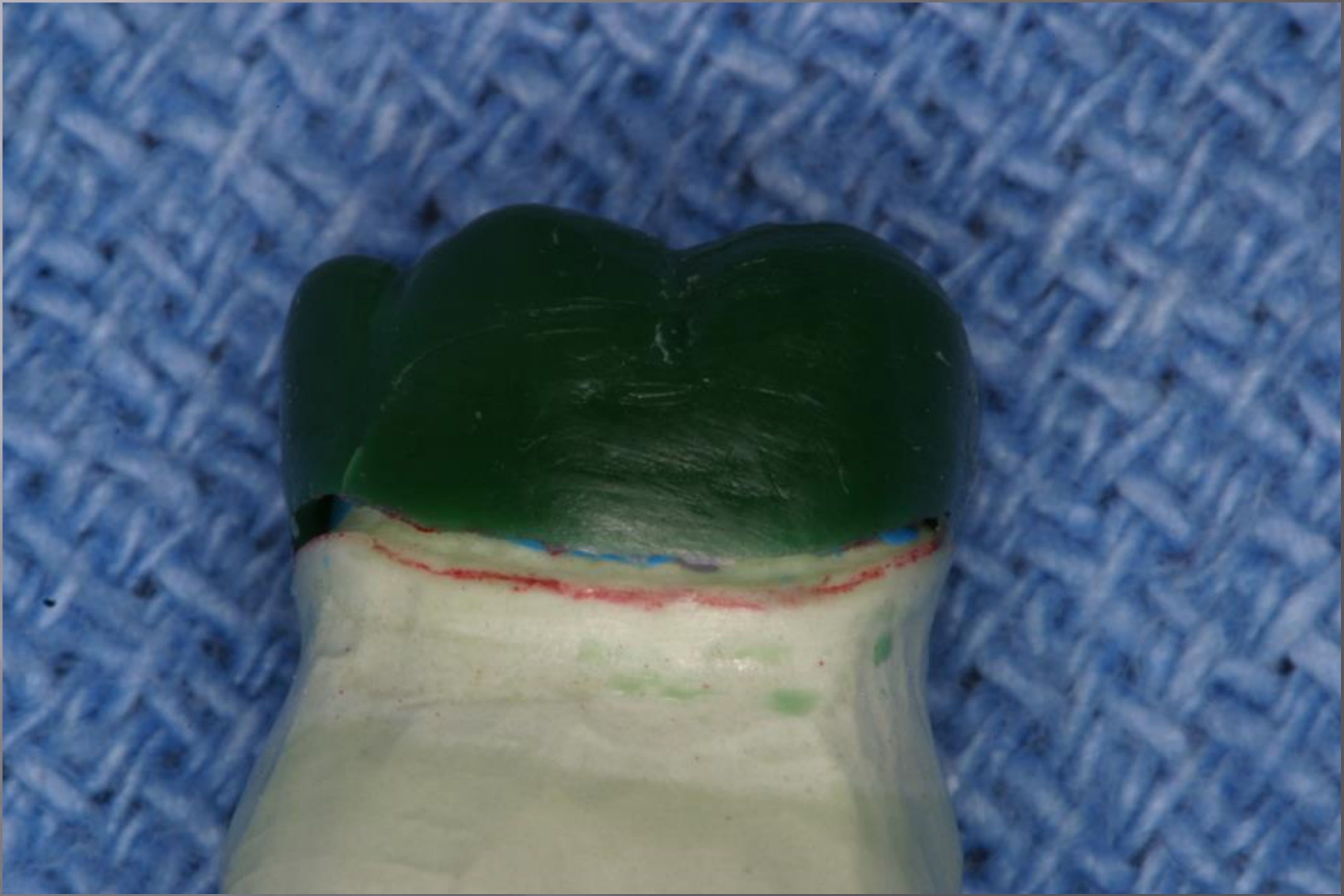


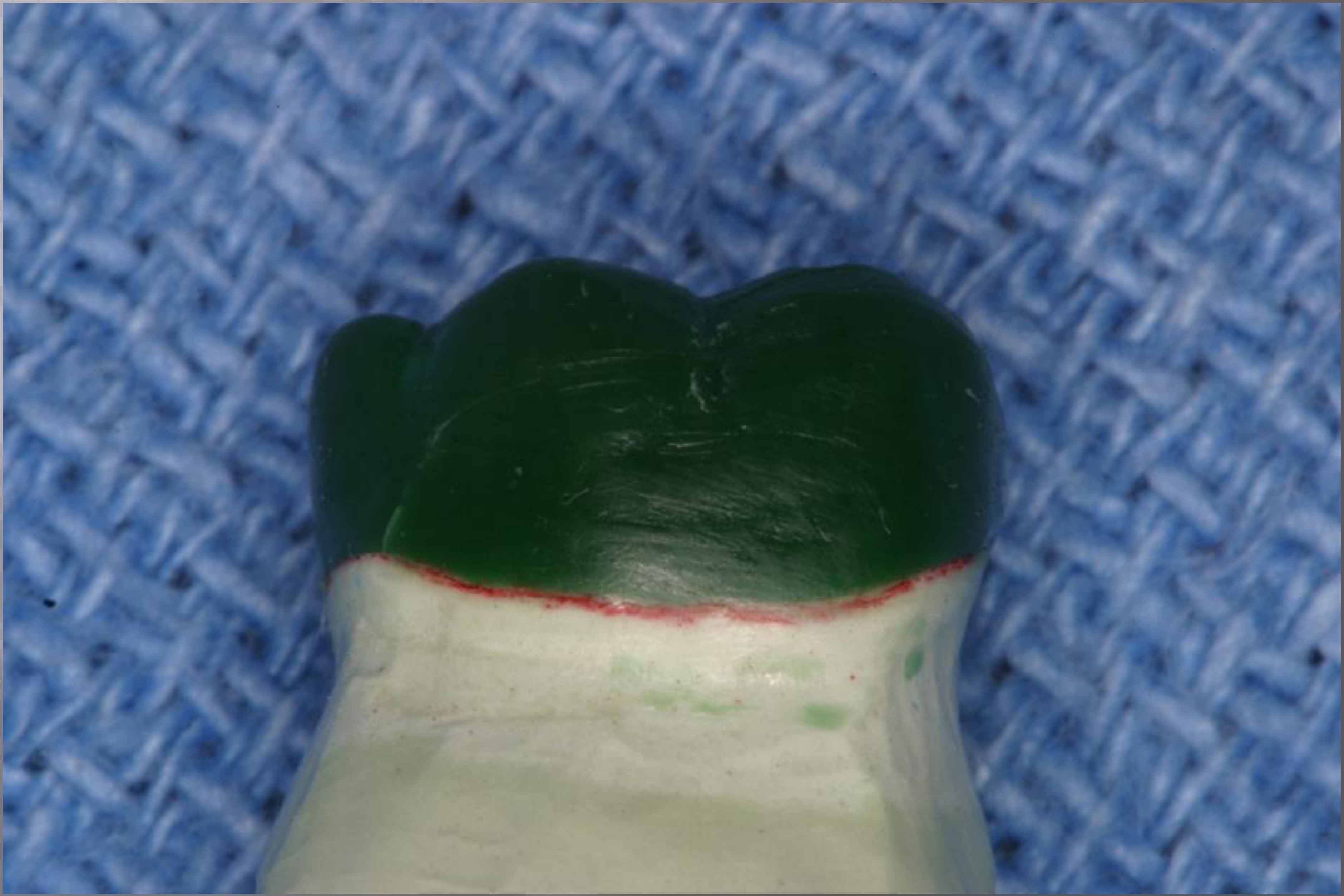


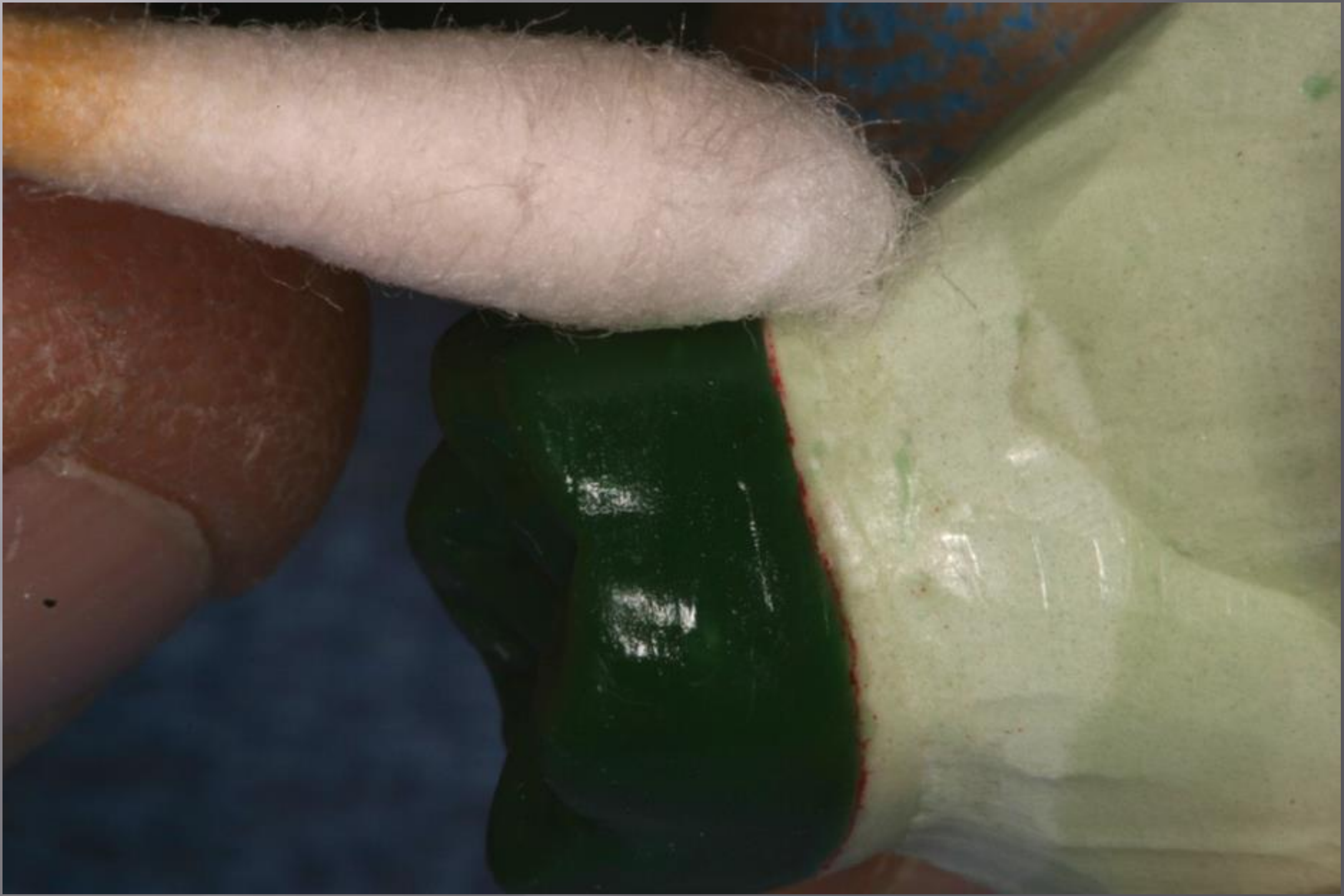


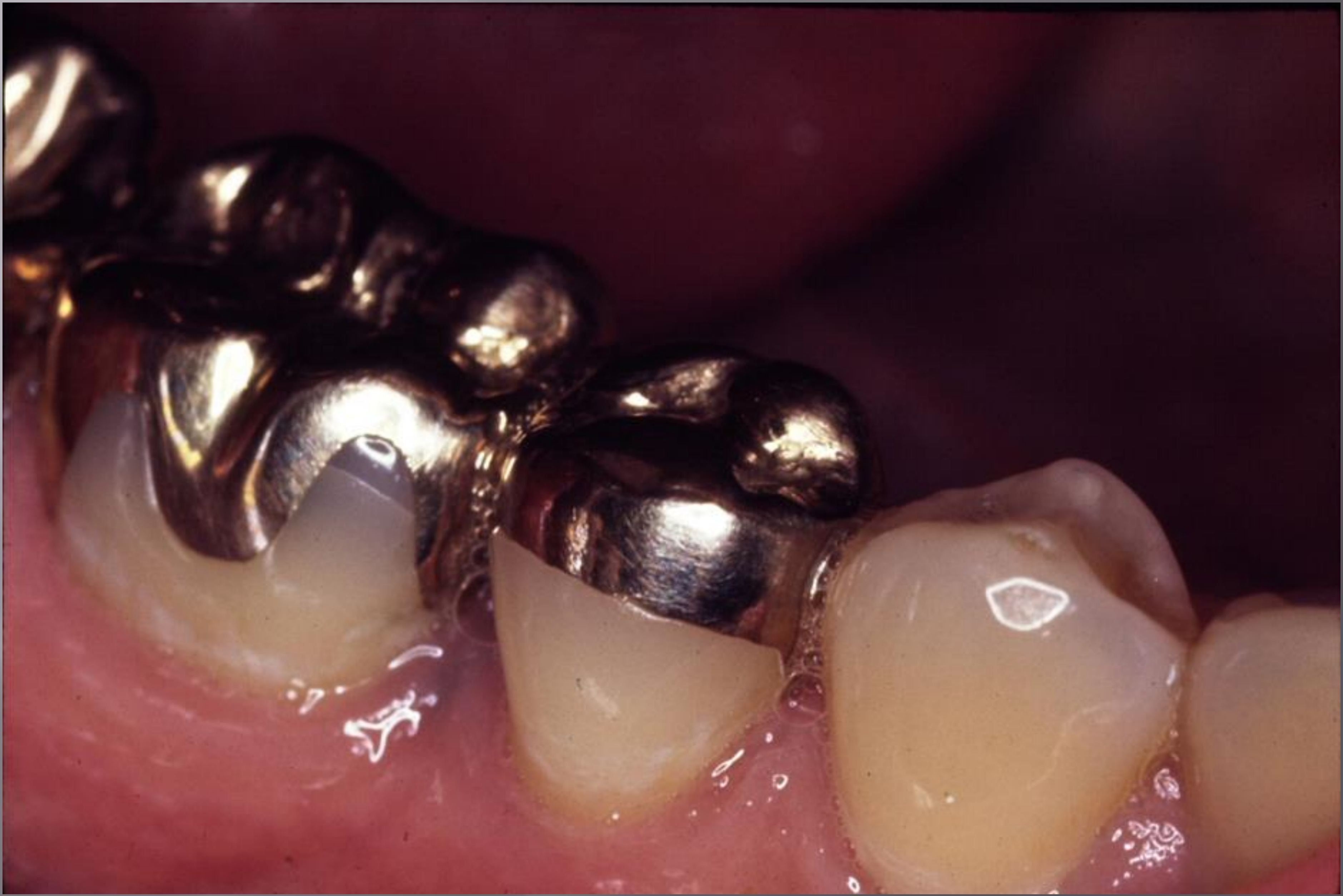










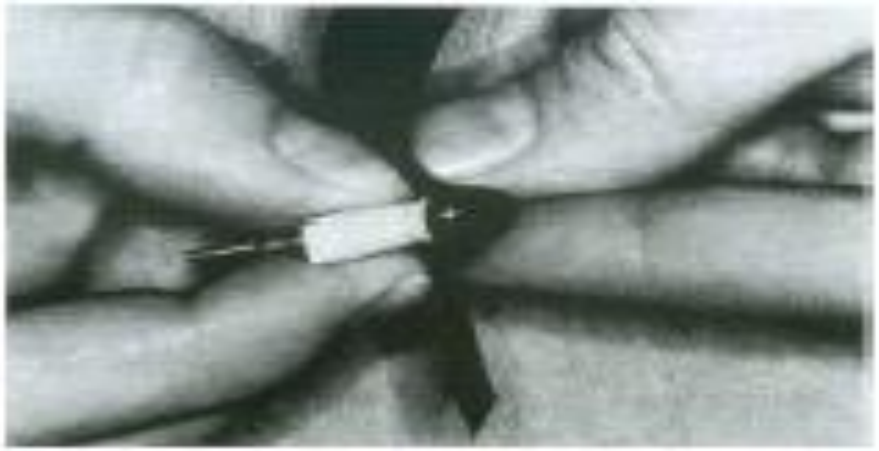


Finalize Pattern

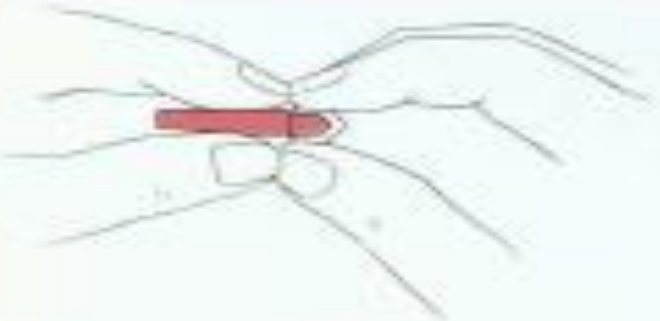
- Examine margins of wax pattern using stereomicroscope.
- Remove flash (wax beyond finish line).
- Add to pattern where it is short of the finish line.
- Smooth pattern and polish.
- Prepare for investing the pattern.

Wax pattern removal.

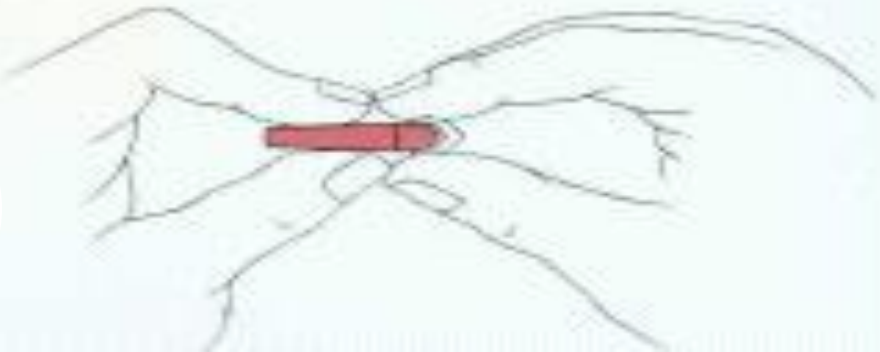
A



B



C



A, A sheet of rubber dam increases friction and aids removal.

B, The fingers of the left hand hold the die. The right hand holds the pattern.

C, The die is pulled from The pattern by bending the fingers of the left hand

After building the wax copping and before carving the wax, copping must be removed and reseated several times.